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# Canada's Export Controls

Department of Foreign Affairs and International Trade  
Ministère des Affaires étrangères et du Commerce international

Canada

# Information and Assistance

The issuance of Export Permits is administered by the Export Controls Division of the Department of Foreign Affairs and International Trade. 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.

The Export Controls Division can be contacted at the following:

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**FOR ENQUIRIES ON THE STATUS OF AN  
EXPORT PERMIT APPLICATION:**

Call (613) 996-2387 and quote your export permit application  
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# A Guide to Canada's Export Controls

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# A Guide to Canada's Export Controls

## Foreword

### General

This publication is a guide to Canada's export controls and has been prepared for the information and guidance of exporters. It does not have the force of law, nor does it cover all goods which may be subject to export controls and which may require export permits.

### Basis for Export Controls

The Export and Import Permits Act (EIPA), the Export Control List (ECL) and the Area Control List (ACL) are the mechanisms by which Canada controls exports. The Act authorizes the Government to exercise export controls over natural resources to encourage further processing in Canada, to limit the export of goods in circumstances of surplus supply or depressed prices, to restrict the export of softwood lumber products, to ensure that there is an adequate supply and distribution of any article, to enact intergovernmental arrangements or commitments and to ensure that military or strategic goods are not exported to destinations representing a strategic threat to Canada.

### Exports to the 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 and of Group 4 as well as some goods in Group 5.

### Re-export of United States Origin Goods

United States origin goods are controlled for re-export from Canada under Item 5400 of Group 5. Although this means all non-strategic U.S. origin goods require an export permit, exporters may benefit, in most cases, from the provisions of General Export Permit No. Ex. 12. Canadian exporters of U.S. origin goods should be aware that depending upon the nature of the goods and the country of destination, exporters may be required to provide a copy of a U.S. export license or verification that such goods may be exported to the specified country without the U.S. license, prior to issuance of a Canadian export permit. Contact the Export Controls Division for more information.

### Area Control List (ACL)

Exporters are advised that even if goods are not identified in any of the ECL Groups in this Guide, export permits are required for the export of all goods to ACL countries. There are currently seven countries on the ACL: Angola, Bosnia-Herzegovina, Croatia, Haiti, Libya, South Africa and Yugoslavia.

## How to use the Guide to Canada's Export Controls

This Guide identifies goods and technologies subject to Canadian export controls pursuant to the EIPA.

This Guide is divided into eight (8) Groups of goods and technologies. A non-exhaustive but helpful Index listing goods in all eight Groups follows Group 8. A list of Definitions of terms used in Groups 1, 2 and 3 follows Group 3, Definitions used in Group 4, Part II, Group 6 and Group 7 follow their respective Groups also.

### Group 1 - International Industrial List

This Group comprises dual-purpose goods and technologies: that is, goods and technologies that have both civilian and military applications.

### Group 2 - International Munitions List

This Group comprises goods and technologies that are specially designed or modified for military purposes.

### Group 3 - International Atomic Energy List

This Group includes goods that are nuclear-related.

### Group 4 - Nuclear Non-proliferation List

This Group also includes goods that are nuclear-related as well as dual-use, civilian goods that could be used in the proliferation of nuclear weapons or nuclear explosive devices. The goods and technologies described in this Group encompass the Zangger List as well as goods subject to control by the Nuclear Suppliers' Group.

## **Group 5 - Miscellaneous Goods List**

Group 5 covers miscellaneous goods that are controlled in order to protect natural resources and to fulfil Canada's commitments to non-strategic multilateral agreements. Included in this Group are forest products, endangered species (flora and fauna), medical products, agricultural and food products, U.S. origin goods and automatic weapons.

## **Group 6 - Missile Technology Control Regime (MTCR) List**

This Group includes goods and technologies agreed upon by the MTCR and that are used or could be used in the proliferation of systems capable of delivering chemical, biological or nuclear weapons.

## **Group 7 - Chemical and Biological Weapons Non-proliferation List**

This Group encompasses chemicals and biological agents as well as related dual-use equipment used in the proliferation of chemical or biological weapons as identified and agreed by the Australia Group.

## **Group 8 - Chemicals for the Production of Illicit Drugs List**

This Group contains a list of precursor chemicals that could be used in the production of illicit drugs. These have been identified and agreed to by the Chemical Action Task Force (CATF). Some of the chemicals are also subject to controls imposed under the "United Nations Convention Against Illicit Traffic in Narcotic and Psychotropic Substances" ratified by Canada in November 1990.

## **Index**

This Guide also includes an Index. Exporters are encouraged to review the Index which will assist them in determining where or if their goods are controlled. Exporters are cautioned, however, that the Index is not all-inclusive and that generic names or other terms are used in place of common or trade terminology.

## **Goods Identified Under More Than One Group/Item of This Guide**

Each Group of this Guide must be considered independently but goods or technologies identified in one Group/Item may also be identified in other Groups/Items. Exporters should ensure that they have reviewed this Guide in sufficient detail to assure themselves that all relevant Groups/Items have been considered.

Where a particular good is included in more than one Group/Item, exporters may find that one Group/Item may control the good to all or most destinations while the other Group/Item may exclude certain specified countries. For example, in Group 7, "Chemical and Biological Weapons Non-proliferation", all items in that Group are controlled to all but twenty-five countries who are members of the Australia Group. At the same time, some of the goods included in Group 7 are included in Group 2, "International Munitions List". Group 2 items are not controlled if destined to the United States but are controlled for all other countries. However, if the goods or technologies proposed for export are included in both Groups 2 and 7 of this Guide and the destination is, for example, France (one of 28 Australia Group members), then Group 2 controls remain for France even though that country is excluded from Group 7 controls. Under this scenario an export permit would be required for France because of Group 2 controls.

## **Brief History of Canada's Multilateral Commitments**

### **COCOM**

Canada has been a member of the Coordinating Committee for Multilateral Strategic Export Controls (COCOM) since 1950. In November 1993, COCOM members noted that the considerations that necessitated the establishment of the COCOM arrangement and the application of a wide range of multilateral East/West trade controls on military, dual-use and nuclear goods are no longer present. It was therefore decided that these controls should be phased out and that the COCOM arrangement terminated by March 31, 1994.

Taking into account the present security situation, COCOM members agreed that instead, a new multilateral arrangement should be established coincidentally, to promote greater transparency and responsibility with regard to transfers of armaments and sensitive dual-use goods and technologies.

### **New Arrangement**

At the time of writing, meetings to establish the new arrangement were continuing. However, the basic concept of the new arrangement is to promote transparency and greater responsibility in transfers of conventional weapons and sensitive dual-use items and to bring multilateral trade controls in line with the new political realities of the post-Cold War era. In addition to the seventeen COCOM members, it is expected that the new arrangement will include non-COCOM countries as well.

In the event that the new arrangement is not in place by the time COCOM is dissolved, COCOM members have agreed to continue to exercise vigilance over the control of goods remaining on the three COCOM lists. Controls, however, will be subject solely to national discretion. That is, the multilateral export control procedures which imposed a consensus rule whereby all COCOM members were required to approve exports to COCOM proscribed countries will disappear on March 31, 1994. The three lists of controlled goods and technologies are reproduced in this Guide under Groups 1, 2 and 3, respectively.

### **Nuclear Non-proliferation**

Canada has a long-standing nuclear non-proliferation policy which is designed, *inter alia*, to ensure that Canada's nuclear exports are not used for any nuclear explosive purpose. Canada has concluded with its nuclear trading partners bilateral cooperation agreements in which there are reciprocal commitments.

As a party to the Treaty on the Non-proliferation of Nuclear Weapons (NPT) that came into force in 1970, Canada is obliged not to provide source or special fissionable material, or equipment or material especially designed or prepared for the processing, use or production of special fissionable material to any non-nuclear weapon state for peaceful purposes unless the source or special fissionable material is subject to International Atomic Energy Agency (IAEA) safeguards. In the early 1970's, Canada, as a member of a group of states that became known as the Zangger Committee, adopted a common interpretation with respect to the implementation of this commitment that included the definition of nuclear goods requiring the application of IAEA safeguards.

In the late 1970's, a group of nuclear suppliers, including Canada, agreed on a further set of guidelines for nuclear transfers to any non-nuclear weapon state for peaceful purposes. These became known as the Nuclear Suppliers' Group (NSG) guidelines. More recently, in 1992, the NSG established a list of nuclear-related dual-use goods and technologies that could make a major contribution to a nuclear explosive activity or an unsafeguarded nuclear fuel cycle activity.

Goods and technologies subject to control under Canada's nuclear non-proliferation policy, as well as its bilateral and multilateral commitments, are contained in Group 4 of the ECL.

### **Miscellaneous Non-strategic Export Controls**

Canada is a participant in a number of bilateral and multilateral organizations designed to control the export from Canada of various non-strategic goods. For example, Canada is a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Such goods are controlled under Item 5000 of this Guide. Other products controlled in Group 5 include medical products, forest products and agricultural and food products. Under a bilateral arrangement with the United States, Canada also controls the re-export from Canada of all United States origin goods. Finally, controls over the export of all automatic firearms are exercised under Item 5500 of the ECL.

The specific goods controlled for the above reasons are contained in Group 5 of this Guide.

### **Missile Technology Control Regime (MTCR)**

The MTCR was established in 1987 to reduce and ultimately eliminate the proliferation of systems capable of delivering chemical, biological or nuclear weapons. As of 1994, twenty-five (25) countries are members of the MTCR.

The goods and technologies identified in Group 6 of this Guide encompass MTCR controls.

### **Australia Group**

In 1985, Canada, together with a number of other Western countries, agreed that the proliferation of chemical and biological weapons required immediate attention. The Australia Group controls chemical substances and biological agents and related equipment that could be used in the production of chemical and biological weapons. As of 1994, twenty-five countries, including Canada, were members of the Australia Group.

Chemical weapon precursors and biological agents and related dual-use equipment are identified in Group 7 of this Guide.

### **Chemical Action Task Force (CATF)**

The CATF met in 1990-91 to establish a list of chemical precursors that could be used in the production of illicit drugs. In July 1991, at the London Economic Summit, the G-7 countries endorsed the CATF Report which called on participating nations to control the export of certain defined chemical precursors. Group 8 contains a list of chemical precursors used in the manufacture of illicit drugs. This list is not all-inclusive. Other chemicals used in the production of illicit drugs are controlled by the Department of National Health and Welfare.

# Getting an Export Permit

Export permits are required when the destination is a country on the Area Control List (ACL) or when the goods are on the Export Control List (ECL). There are two types of permits: a General Export Permit (GEP) and an Individual Export Permit (IEP).

## General Export Permits

General Export Permits (GEP) were introduced to minimize the administrative burden of export controls on exporters and to streamline export licensing procedures. GEP's enable an exporter to export certain specified goods which are subject to control to eligible destinations without the necessity of submitting an export permit application. GEP's are simple to understand and easy to use. These GEPs, which are identified in sub-section I of the next part of this Guide, are available on request.

## Individual Export Permits

When an export permit is required and a GEP cannot be used, an Individual Export Permit (IEP) must be obtained. The export permit is requested by completing an "Application for Permit to Export Goods", form No. EXT 1042.

## Submission of Applications

Once the application form is completed and the necessary technical and supporting documentation is compiled, forward all documentation together with the application to the address noted on the inside of the front cover of this Guide (except for wild fauna and flora controlled under Item 5000, see next paragraph).

## Endangered Wild Fauna and Flora—Applications

Canada is a signatory to the Convention on International Trade in Endangered Species (CITES). Controlled fauna and flora are included under Item 5000 of this Guide. Export permits are required and issued by:

The Administrator  
Convention on International Trade in Endangered Species  
Canadian Wildlife Service  
Environment Canada  
Ottawa, Ontario  
K1A 0H3  
Telephone: (819) 997-1840

## Nuclear and Atomic Energy Goods and Technologies

The export of any goods or technologies subject to individual export permits under Groups 3 and 4 of this Guide requires an individual licence issued by the Atomic Energy Control Board (AECB). In such cases, the licence is granted on the export permit and does not need to be requested separately. However, the export of certain radioactive material not identified in this Guide, as well as some Group 3 and 4 goods not subject to individual export permits but qualifying for General Export Permits, require an export licence separately from the AECB. Information relating to such controls may be obtained by contacting:

Atomic Energy Control Board  
Non-proliferation, Safeguards and Security Division  
P.O. Box 1046, Station B  
Ottawa, Ontario  
K1P 5S9  
Telephone: (613) 995-0369  
Facsimile: (613) 995-5086

## Further Information

The Export Controls Division also publishes Notices to Exporters which set out in greater detail the legal and policy guidelines associated with export controls as well as the various administrative mechanisms in place. Copies of these Notices, which are identified in sub-section J of the next part of this Guide, are available on request.

# Canadian Export Control Law and Policy

## A. General

The following outlines the policy and procedures governing export permits for military, nuclear and strategic goods and technology. This information supersedes *Notice to Exporters*, Serial No. 67 of July 1, 1993 entitled *Canadian Export Control Law and Policy: Requirements for Obtaining Export Permits*.

### 1. Background

The Minister of Foreign Affairs is designated by the Governor-in-Council as the Minister responsible for the Act, including the issuance of export permits. The Export and Import Permits Bureau of the Department of Foreign Affairs and International Trade is responsible for administration of the Act.

### 2. The Area Control List (ACL)

Permits are required for all exports to countries on the ACL, regardless of whether the goods or technologies are listed on the Export Control List.

### 3. The Export Control List

- a. Goods and technologies may be placed on the ECL to fulfil domestic supply commitments or international economic and trade related arrangements.
- b. In a number of cases goods and technologies are placed on the ECL to fulfil international commitments regarding the proliferation of weapons of mass destruction and to deny potential adversaries access to military goods and industrial goods which may have a military or strategic application.
- c. Goods and technologies which are subject to Canadian export controls and that require a permit are classified into eight (8) Groups in this Guide.

### 4. Automatic Firearms Country Control List (AFCCCL)

- a. Automatic firearms may be exported only to countries with which Canada has intergovernmental defence, research, development and production arrangements. Those countries are listed on the AFCCCL.
- b. The AFCCCL is as follows:
  - Australia
  - Belgium
  - Denmark
  - France
  - Germany
  - Italy
  - Netherlands
  - Norway
  - Saudi Arabia
  - Spain
  - Sweden
  - United Kingdom
  - United States
- c. Export permits are required for exports of automatic firearms as defined in ECL Item 5500 and the Criminal Code. Permits will not be issued for the export of automatic firearms to any country not listed on the AFCCCL.

## B. Export Permits

### 1. Introduction

- a. Export permits are required when the destination is a country on the ACL or when the goods are on the ECL.
- b. There are two types of export permits: an Individual Export Permit (IEP) and General Export Permit (GEP).

### 2. Individual Export Permits (IEP)

- a. An Individual Export Permit (IEP) must be obtained in order to export any goods to ACL countries unless an exemption is granted to an IEP under a particular GEP. As well, an IEP is required for goods on the ECL to all countries unless otherwise indicated. (In most cases, ECL goods to the U.S. do not require export permits).

- b. To apply for an export permit fill out an "Application for Permit to Export Goods" (EXT 1042). Specific instructions on how to complete the application form are contained on the last page of this "Guide".
- c. In 1993 the export permit application was revised and re-issued under "EXT 1042 (09/93)". A copy of the revised form is reproduced on the inside of the back cover. Permit application forms that pre-date the 1993 revision may still be used.

### 3. General Export Permits (GEP)

- a. General Export Permits (GEP) were introduced to minimize the administrative burden of export controls on exporters and to streamline export licensing procedures. General Export Permits are listed in sub-section I.
- b. It is important to remember that:
  - i. for less sensitive goods, a GEP is a means of reducing the burden of controls on exporters by effectively removing the need to apply for an individual export permit;
  - ii. a GEP is available for use by any Canadian resident;
  - iii. a GEP is a valid export permit and the conditions attached to its use are legally enforceable; **and**
  - iv. no prior authorization is required from the Minister to use a GEP.
- c. Exporters should ensure that the goods to be shipped qualify for a GEP and that the conditions for the use of a GEP are fulfilled.

## C. Policy Guidelines

### 1. General

The Minister of Foreign Affairs is responsible for the implementation of the *Export and Import Permits Act*. The Export Controls Division, Export and Import Permits Bureau administers, on behalf of the Minister, Canadian policies and procedures related to controls on specific goods and technologies. There are established guidelines, procedures and policies with respect to exports of strategic and military goods.

### 2. Strategic Goods

Groups 1, 3, 4, 6 and 7 of the Export Control List cover strategic goods and technologies. Groups 4 and 7 of the ECL also cover dual-use materials, equipment and components which could contribute to uncontrolled chemical, biological and nuclear weapons proliferation. Generally, exports of strategic civilian goods are considered favourably except where there is a risk of diversion of these goods to an unacceptable use as determined by international agreements or arrangements. An application may be denied where there is a risk of proliferation of nuclear weapons (Group 4), missile systems (Group 6) or chemical/biological weapons (Group 7) to any country.

### 3. Military Goods

With respect to military goods, (ECL Group 2 and ECL Item 5500) Canadian export control policy has, for many years, been restrictive. Under present policy guidelines set out by Cabinet in 1986, Canada closely controls the export of military goods and technology to:

- i. countries which pose a threat to Canada and its allies;
- ii. countries involved in or under imminent threat of hostilities;
- iii. countries under United Nations Security Council sanctions; or
- iv. countries whose governments have a persistent record of serious violations of the human rights of their citizens, unless it can be demonstrated that there is no reasonable risk that the goods might be used against the civilian population.

### 4. Policy Assessments

After the technical assessment is completed, a permit officer will review the application. The officer will take into consideration the type of goods exported, the importing country and the intended use of the product. A thorough examination of the relevant foreign policy and security concerns relating to the proposed export is also undertaken.

### 5. Consultations

- a. The purpose of intra/interdepartmental consultations is to fully assess the risk of unauthorized diversions, trans-shipments or possible misuse of products for export. Consultations may be carried out at the national, bilateral or multilateral levels.
- b. Various Canadian Government Departments, Agencies or Boards may be involved in the export control process. These may include the Departments of National Defence, Communications, Industry, and Revenue Canada (Customs and Excise); the Atomic Energy Control Board; the Communications Security Establishment; the Canadian Security Intelligence Service; the Royal Canadian Mounted Police (R.C.M.P.); and, various Divisions within the Department of Foreign Affairs and International Trade.

## D. Issuance of an Export Permit

### 1. Introduction

- a. The Export Controls Division examines all applications for export permits on a case-by-case basis. The turnaround time for an application will vary depending on the nature and sensitivity of the product and the country of destination. Please allow for up to 30 days for the processing of the application. The approved "Application for Permit to Export Goods" shall not be altered or amended except by or on behalf of the Minister.
- b. All export permits for military goods (ECL Group 2 • Munitions or ECL Item 5500) are issued on condition that a quarterly report of shipments made against each export permit be submitted to the Export Controls Division.

### 2. Temporary Export Permits

- a. Exporters wishing to export controlled goods for trade shows, exhibitions, demonstrations, etc., must apply for an export permit in the usual manner. Exporters should clearly identify this in the body of the application. Applications for such permits may be subject to the same consultative procedures as regular permit requests.
- b. If an export permit is issued, the exporter must agree to comply with all terms and conditions attached to the export permit. These conditions may include:
  - i. adhering to the period of validity governing export of the goods;
  - ii. ensuring that the goods are properly supervised while abroad; and
  - iii. providing verification when the goods are returned to Canada.Other conditions may also apply.

### 3. Approvals-in-Principle

- a. Requests for approval-in-principle must provide full information on an eventual export transaction, including a complete description of the product(s) and their use, identity of the end-user and any special circumstances.
- b. Approval-in-principle involves the same intra/interdepartmental consultation and the same turnaround time as formal permit applications.
- c. The receipt of an approval-in-principle does not negate the requirement to apply for and obtain a specific export permit. While it provides some assurance that an export permit would be approved, this is conditional on the circumstances surrounding the potential export not changing appreciably between the time the approval-in-principle is granted and the submission of an export permit application.

### 4. Validity Period of Permits

- a. As a general rule, export permits for ECL Groups 1, 4 (Part II only), 6, 7 and 8 as well as for ECL Item 5400 are valid for two years. Extensions will not be considered.
- b. Permits for ECL Groups 2, 3 and 4 (Part I only) as well as most goods in Group 5 are valid for one year or less. A one year extension of these permits will be considered on a case-by-case basis.

### 5. Single Shipment Permits (Offensive Military Equipment)

As a general rule, export permits for military goods falling under ECL items 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009 (a) and (g), 2010 (a), 2016, 2017 (b), 2023, 2026 and ECL Item 5500 will be issued for single shipment/single consignee only. The export permit becomes invalid after the first shipment is made even if the shipment was only a partial one. Exporters would have to re-apply for a new export permit to cover any shortfall.

### 6. Multiple Shipments/Single Consignee Permits (Non-offensive Military/Atomic Energy Equipment)

Other ECL items in Group 2 not identified above and all items in ECL Groups 3 and 4 (Part I only) may be permitted to a single consignee on a multiple shipment basis.

### 7. Multiple Shipments/Multiple Consignee Permits (Strategic/Other Goods)

An exporter may use an export permit for more than one shipment to the consignees specified on the export permit (maximum of three consignees per permit allowed) and up to the value and quantity noted on the permit, unless otherwise indicated on the export permit. This procedure applies to all goods in Groups 1, 4 (Part II only), 5 (except ECL Item 5500), 6, 7 and 8.

## 8. Forest Products

An "Application for Permit to Export Goods" of forest products from all provinces classified under items 5101, 5102 or 5103 of the ECL should be forwarded to the Export Controls Division. For additional information, please refer to sub-section F.

## 9. Technical Information

Complete technical specifications of the goods to be exported must accompany each application in order for the Technical Officer in the Export Controls Division to determine if the goods are controlled, under what ECL item the goods are controlled, and at what level the goods are controlled. Upon receipt of the application, a technical officer will assess the product. The lack of technical documentation will delay the processing of applications.

## 10. Supporting Documentation

- a. Canada and its major industrialized trading partners have harmonized their export control systems in order to prevent unauthorized diversions or transshipments of controlled commodities.
- b. Canada has therefore introduced, along with members of the various non-proliferation regimes, as well as certain other countries, a procedure of end-use assurances. End-use assurances appear in the form of International Import Certificates (IIC), End-use Certificates (EUC), Import Licences (IL), Delivery Verification Certificates (DV) and End-use Statements (EUS). Complete details on these end-use assurances are contained in sub-section G.
- c. In order to expedite the processing of export permit applications exporters are encouraged to obtain IICs, DVs, EUCs, ILs or EUSs from the importers well in advance of applying for an export permit. This ensures that applications are processed with minimal delays.
- d. Under certain defined circumstances, the need for an EUC, IIC, IL, EUS or DV may be waived. Please refer to sub-section G where the waivers are explained in detail.

## 11. Export Permit Fees

A fee of \$15.00 is charged only for those export permits covering items under ECL Group 5 with the exception of ECL Items 5400, 5401 and 5500. There is no charge for permits classified under any other ECL Item numbers. This fee, in the form of a cheque or money order payable to the Receiver General of Canada (no cash) must accompany each export permit application. An export permit will not be issued unless full payment has been received (See Notice to Exporters No. 50 "Export and Import Permits and Certificates Fees Orders, 1989" for complete details).

## 12. Application for Permit

An "Application for Permit to Export Goods" (form EXT 1042) can be obtained from the Export Controls Division or from any federal International Trade Centre located in each province. The specific offices where these forms may be obtained are identified on the back cover of this Guide. Instructions on how to complete the application form are contained on the back of the last page of the form itself and are reproduced on the last page of this Guide.

## 13. Status Enquiries

Exporters may obtain information regarding the processing of their permit application by contacting the direct telephone number (613)996-2387 and citing the red I.D. number on the export permit application. Without this number it is very difficult to provide a timely response. Please allow at least five (5) working days from time of mailing before enquiring as to the status of applications.

## 14. Distribution of Permit Copies

- a. Once the export permit has been approved, the exporter will receive an "Exporters Copy" duly signed and authorized. This copy must be presented to Customs at the port of export together with the appropriate shipping documents and Customs Declaration Form (if applicable). If the permit allows multiple shipments, then a photocopy of the "Exporters Copy" must be submitted to Customs for subsequent shipments.
- b. The exporter must retain, at his/her place of business or residence, all documents in respect of each export made under an export permit whether it be a General Export Permit (GEP) or an Individual Export permit (IEP), for a period of six years.

## 15. Amendments

- a. Requests for amendments must be made in writing, addressed to the Director, Export Controls Division. All such requests should be received in the Division at least four weeks before the expiry date of the export permit.
- b. Requests for amendments are reviewed individually in light of the circumstances prevailing at the time of the request. Extensions will be approved on a one time basis only for permits originally issued with an expiry date of one year. Where a permit is issued with a expiry date of two years, no extension will be approved.
- c. Unless otherwise indicated above, the number of consignees per permit is limited to three. Amendments will be considered although no increase in the number of consignees beyond three will be allowed. Changes in consignee must be accompanied by end-use certificates (EUC) or International Import Certificates (IIC).
- d. New items may not be added to an existing permit. Companies are asked to submit a new application for permit to export those goods. Requests to change the quantities or values indicated on existing permits will be reviewed on a case-by-case basis. Such amendments to permits covering military goods (ECL Group 2) will generally be approved only when the changes are of a minor nature.

**Note:**

Once the permit has expired, it cannot be amended.

## 16. Access to Information

As a general rule, under the *Privacy Act* and the *Access to Information Act*, information in the possession of the federal government cannot be disclosed, regardless of the source of such information. However, both the *Privacy Act* and the *Access to Information Act* contain provisions which allow the government to disclose certain information under certain circumstances. Please refer to the Acts for more information.

## E. Customs

### 1. Introduction

Before allowing the export of goods, it is the duty of Customs Officers, under the *Export and Import Permits Act* (EIPA) and the *Customs Act*, to satisfy themselves that the export does not contravene the EIPA.

### 2. Customs Documents

- a. At the time the goods are presented for export it is necessary to present a completed Customs and Excise Declaration form B-13 (if one is required) along with the exporter's original copy of an export permit. In those instances where the exporter is unable to provide the original copy, an export permit stamped "this is a certified true copy" and signed by the appropriate officer of DFAIT will be accepted. It is the responsibility of the exporter to declare on the B-13 (Box 9) the Permit No. and whether or not the goods require an export permit. If a permit is required, the Individual Export Permit number or the General Export Permit number must be cited. If no permit is required, this fact must be stated on the export documentation.
- b. For permits valid for multiple shipments, it is the responsibility of the exporter to present the original copy of the export permit to Customs at the time of the first exported shipment. Copies of attachments listing consignees, goods etc., must also be presented with the same information stated on the B-13 (i.e. consignee name and address). Photocopies will be accepted for all additional exports. Each shipment will be recorded by Customs until the export permit expires or the quantity/value of the export permit has been reached, whichever comes first. However, it should be noted that it is the responsibility of the exporter to keep records and not to ship beyond the limits of the export permit.
- c. For more information on presentation and processing of Customs export documents, please contact your local Customs office.

### 3. Detained Goods

- a. Exporters whose goods are being detained by Customs should contact the Detention Liaison Clerk, Export Controls Division, Department of Foreign Affairs and International Trade. If the detained goods are controlled under the Export Control List or require a permit because they are destined for a country on the Area Control List, the exporter will be required to obtain and present to Customs the valid export permit before the goods will be considered for release. Before an export permit may be issued, the exporter may be requested to provide additional information in order to have the goods properly assessed.
- b. Exporters found to be in violation of the *Export and Import Permits Act* (EIPA) may have their goods seized by Canada Customs. In these instances, the exporter may be liable for severe penalties under the *Customs Act* or the *EIPA*. Following seizure, Canada Customs has the sole responsibility of all seized goods.

- c. Permits will not be issued for goods under seizure until such time as the goods are released to the exporter.

**Reminder: Canada Customs compares the goods described on the export permit and the Customs Declaration form B-13 or equivalent export documentation. Discrepancies in the documentation could result in the export being detained, pending clarification.**

## F. Forest Products

### 1. General

Federal permits for the export of Forest Products as defined in the Export Control List, Group 5, from all provinces and territories in Canada are issued by the Department of Foreign Affairs and International Trade in Ottawa. All export permit applications to export forest products should therefore be submitted to the Export Controls Division.

### 2. Forest products originating from British Columbia

Forest Products as defined in the Export Control List (ECL) Group 5 and being exported from British Columbia require consultation with the Provincial government to determine adequate supply. Once the B.C. Ministry of Forests has given a favourable recommendation for the export of logs, exporters should forward copies of the valid provincial permits (Form FS-34) and the relevant form (FS-38) to the Export Controls Division along with the federal application (EXT 1042). For woodchips exported from B.C., exporters should submit to this office a copy of the relevant *Order of the Lieutenant Governor in Council* issued by the Province of British Columbia along with the federal application (EXT 1042). The federal export permit, once issued, will be sent to the applicant/exporter.

### 3. Forest Products Originating from Indian Reserves in British Columbia

In the event the logs in question originate from Indian Reserves in B.C., please ensure that the following information is included on the Federal application form (EXT 1042): The appropriate Timber Mark should be indicated next to each Boom Number. Indicate and add the number of pieces of information next to the volume per each boom. Ensure a letter of consent issued by Northern Development accompanies your application. Information concerning this letter of consent should be directed to:

Mr. Nenad Kotic  
Lands and Resources, B.C. Region  
300-1550 Alberni St.  
Vancouver, B.C.  
V6G 3C5  
Telephone: (604) 666-6755  
Facsimile: (604) 666-3808

### 4. Forest Products Originating from the Yukon

Applications for Forest Products as defined in ECL Group 5, which originate from the Yukon require that the Department of Foreign Affairs and International Trade (DFAIT) consult with Indian and Northern Affairs Canada (INAC), Whitehorse Regional Office, which, in turn will consult with the Minister for Economic Development, Government of the Yukon to determine adequate supply before a federal export permit can be issued. Pending the outcome of this consultation procedure, exporters will be advised by the Export Controls Division as to whether or not an export permit will be issued. Exporters are advised to submit their applications to the Export Controls Division and to allow 20 working days from receipt of their application for this office to complete such consultation requirements.

### 5. Export Permit and Certificate Fees

- a. Under the authority of the *Export and Import Permits Act and Certificates Fees Order, 1989*, a fee of \$15.00 is levied for each export permit for the export of goods included on the Export Control List (ECL) under Group 5 except Items 5400, 5401 and 5500. Exporters must submit with their application a cheque or bank money order, (no cash) payable to the Receiver General for Canada in the amount of \$15.00 for each permit requested.

- b. Frequent exporters may apply to the Export and Import Permits Bureau for the authority to be placed on the monthly billing system in place of individual payments for each application. Companies that wish to apply for this privilege should submit their request to the Director General, Export and Import Permits Bureau (EPD), Department of Foreign Affairs and International Trade, P.O. Box 481, Station "A", Ottawa, Ontario K1N 9K6. The following information should be provided with the request:
  - i. name and address of the company;
  - ii. company file number, if known;
  - iii. mailing address for forwarding monthly invoice;
  - iv. point of contact with telephone number or person responsible for payment of invoices; and
  - v. justification for request.

## G. Supporting Documentation

### 1. Import Certificates/End-use Certificates/Import Licences

An International Import Certificate (IIC), End-use Certificate (EUC) or Import Licence (IL) may be required in support of proposed exports.

#### a. International Import Certificates

- i. When an IIC is required, the exporter must request the importer or consignee to obtain an IIC from the government of the importing country. By this document the importer gives his undertaking to the government of the importing country that the goods specified will not be diverted en route and that in the event of re-export this will be done in accordance with the export control laws of that country.
- ii. Where an IIC is required, it is the responsibility of the importer to complete the official form and to present it to the designated office of the importing country for validation. In preparing the form, it is necessary to describe fully the commodity which must correspond to the commodity description appearing on the export permit. In addition, the quantities and values shown on the export permit application must not exceed those on the corresponding IIC.
- iii. Once the IIC is validated by the foreign authorities, the original as well as the importer's office copy are returned to the importer. The original must then be sent by the importer to the Canadian exporter, who will forward it to the Export Controls Division.
- iv. Where there is a continuing business relationship between the importer and the exporter, the importer may prefer to obtain an IIC covering several successive orders. The same form is used as for a single transaction import certificate and the same procedure is followed.
- v. IICs usually have a limited validity period (normally 6 months) and must be submitted to the Export Controls Division within the validity period.

#### b. Delivery Verification Certificates (DV):

- i. Most countries that issue IICs also issue Delivery Verification Certificates (DV). DVs certify that the goods have arrived in the importing country. On some occasions, exporters may be required to provide DVs.
- ii. The certificates referred to above are normally issued by import or export control authorities in the country of final destination and are required to ensure that exported goods are not diverted or trans-shipped and that they arrive at the destination indicated. Canadian exporters must obtain such certificates from importers, who request them from authorities in their countries.
- iii. Delivery Verification certificates may also be required at any time there may be a concern regarding ultimate destination, end-user, etc. The DV provides official confirmation that the goods have been delivered in accordance with the terms of both the Canadian export permit and the foreign IIC.
- iv. The DV is issued by the designated office of the importing country. It is requested by the importer who forwards it to the Canadian exporter who, in turn, submits it to the Export Controls Division.

#### c. End-Use Statements (EUS)

Some governments do not issue any type of end-use certificates or assurances. In such cases an end-use statement from the importer may be acceptable. The original statement required is to be on the importer's letterhead (photocopy not acceptable) and must:

- i. identify the end-user as well as purpose and use of the imported products to be imported;

- ii. correspond to the commodity description which appears on the export permit application;
- iii. identify whether the goods are being used for civilian or military application; and
- iv. declare that the imported goods will not be diverted or re-exported.

#### d. End-Use Certificates (EUC)/ Import Licences (IL)

The Canadian exporter should request the importer to obtain the EUC or IL, whichever is required, from the designated authorities. The importer should forward this document to the Canadian exporter for delivery to the Export Controls Division making reference to the export permit application number.

### 2. General Waiver of Supporting Documentation

At the discretion of the Export Controls Division, the supporting documentation requirements may be waived for applications to export certain goods. In the individual waiver situations noted in paragraphs a, c, d, g, h and i below, the exemption applies only to ECL Group 1 goods.

Exporters who consider that their particular transaction qualifies for waiver of supporting documentation should state this in the body of the export permit application.

#### a. Single Items Less Than \$6,000 (Cdn)

Goods in ECL Group 1 only covered by a single item with a value of less than \$6,000 Canadian.

#### b. Government Departments or Agencies (All ECL Groups)

For an application to export goods to a government Department or Agency in any country, the government consignee as indicated on the B-13 Customs declaration form must take delivery of the goods directly.

- i. The term "government agency" does not include those government corporations, quasi-government agencies, and state enterprises which are engaged in principally commercial, industrial and manufacturing activities such as petroleum refineries, mines, steel mills, retail stores or automobile manufacturing plants;
- ii. Government Departments are entities operated by government-paid personnel performing governmental administrative functions: e.g. Ministry of Defence, Ministry of Health; etc.
- iii. Government Agencies considered to be government controlled (i.e. more than 50% government owned) are public service entities, such as transportation systems, postal, telephone, telegraph, broadcasting and hydro power systems.

#### c. Relief Agencies

For an application to export goods to recognized relief agencies for use in a relief project in a foreign country.

#### d. Educational Institutions

For an application to export goods to an accredited institution of higher learning (e.g. university, academy, college, research institute), the institution must have placed the order directly with the Canadian exporter, and must take delivery of the goods when they are received in the importing country, e.g. it must be the consignee indicated on the export permit application.

#### e. Temporary Permits (All ECL Groups)

For an application to export goods for exhibition, demonstration or testing purposes. In such a case, the export permit when issued, will include a condition that the export permit is for demonstration purposes only and that the goods must be returned to Canada.

#### f. Firearms (ECL Items 2001 and 2003 only)

To export rifles, carbines, revolvers or pistols (except those covered under ECL Item 5500) if the total shipment does not exceed fifteen of these firearms.

#### g. Maintenance/Repair Parts-Commercial Aircraft

For an application to export equipment and/or spare parts intended for the maintenance, repair or operation of commercial aircraft operated by commercial air carriers.

## h. Maintenance/Repair parts – Non-USA Origin Goods

Exports of equipment and/or spare parts intended for the maintenance or repair of non-U.S. origin goods, which were previously exported from Canada under a valid export permit.

## i. Returned Goods

Returned goods are those:

- i. returned from Canada to the foreign country for repair or replacement;
- ii. returned after being repaired in Canada; or
- iii. replace goods previously exported from Canada which have been returned to Canada for replacement.

### Note:

In certain cases, GEP No. EX. 1 may apply to your export in situations identified in paragraphs g, h and i above.

## H. Countries Administering IIC, DV, EUC and IL Requirements

### Country System Administered

Australia	IIC/DV
Austria	IIC/DV
Belgium	IIC/DV
Bolivia	DV
Brunei	IL
Myanmar (Burma)	EUC
Chile	IIC/DV equivalents
People's Republic of China	EUC/MOFERT
Denmark	IIC/DV
Finland	EUC
France	IIC/DV
Germany	IIC/DV
Greece	IIC/DV
Hong Kong	IIC/DV
Hungary	IIC
Ireland	IIC/DV EUC
Israel	IIC/Customs
Certificate in lieu of DV	
Italy	IIC/DV
Japan	IIC/DV
Republic of Korea	IIC/DV
Liechtenstein	Swiss Blue
Luxembourg	IIC/DV
Macau	IL
Malaysia	IIC/DV
Myanmar (Burma)	EUC
Netherlands	IIC/DV
New Zealand	EUC
Nigeria	IIC
Norway	IIC/DV
Pakistan	IIC/DV
Portugal	IIC/DV
Singapore	IIC/DV
Spain	IIC/DV
Sweden	IIC/DV
Switzerland	Swiss Blue
Turkey	IIC/DV
United Kingdom	IIC/DV
United States	IIC/DV
Yugoslavia	EUC

Please refer to sub-section G for detailed information on how to obtain supporting documentation.

## I. List of General Export Permits (GEP'S)

The GEPs currently in force are as follow:

GEP No.	Title
Ex. 1	Export of Goods for Special and Personal Use
3	Export of Consumable Stores Supplied to Vessels and Aircraft
5	Export of Logs
11	Exports to Libya
12	United States Origin Goods
14	Specimens of Endangered Fauna and Flora
20	Exports to South Africa
22	Haiti
24	Croatia
25	Bosnia-Herzegovina
26	Industrial Chemicals
27	Nuclear-related Dual-use Goods
28	Angola

To obtain your copy of any of the above GEPs please contact the Export Controls Division.

## J. List of Notices to Exporters

No.	Subject
23	Export of Logs from B.C.
26	Exports of Red Cedar suitable for Use in the Manufacture of Shakes and Shingles
50	Export and Import Permits and Certificates Fees Order 1989 (Forest Products)
52	Exports of Unprocessed Roe Herring
57	Haiti
59	Republic of South Africa
60	Libya
62	Yugoslavia
63	Croatia
64	Slovenia
65	Bosnia-Herzegovina
71	Angola
72	Nuclear-related Dual-use Goods
74	Chemical and Biological Weapons

To obtain your copy of any of the above Notices, please contact the Export Controls Division.

## K. Acronyms

ACL	Area Control List
AECB	Atomic Energy Control Board
AFCCCL	Automatic Firearms Country Control List
AIA	Access to Information Act
B-13	Customs Export Declaration Form
CE	Customs and Excise
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CSIS	Canadian Security Intelligence Service
DFAIT	Department of Foreign Affairs and International Trade
DV	Delivery Verification Certificate
ECL	Export Control List
EIPA	Export and Import Permits Act
EUC	End-Use Certificate
EUS	End-Use Statement
GEP	General Export Permit
IC	Industry Canada
IEP	Individual Export Permit
IIC	International Import Certificate
IL	Import Licence
EPE	Export Controls Division
MTCR	Missile Technology Control Regime
NPT	Nuclear Non-proliferation Treaty
RCMP	Royal Canadian Mounted Police
UN	United Nations



# Group 1 – International Industrial List

Definitions to the terms set out in quotations are listed in pages 49 to 55 of this Guide and apply in respect to this Group.

## 1000. General Technology Note

The export of "technology" which is "required" for the "development", "production" or "use" of products embargoed in the International Industrial List is controlled according to the provisions in each Category.

"Technology" "required" for the "development", "production" or "use" of a product under embargo remains under embargo even when applicable to any unembargoed product.

Controls do not apply to that "technology" which is the minimum necessary for the installation, operation, maintenance (checking) and repair of those products which are unembargoed or whose export has been authorised.

### N.B.:

This does not release the repair "technology" embargoed by Category 1085.2.a. Controls do not apply to "technology" "in the public domain" or to "basic scientific research".

### General "Software" Note

This List does not embargo "software" which is either:

1. Generally available to the public by being:
  - a. Sold from stock at retail selling points, without restriction, by means of:
    1. Over-the-counter transactions;
    2. Mail order transactions; **or**
    3. Telephone call transactions; **and**
  - b. Designed for installation by the user without further substantial support by the supplier; **or**
2. "In the public domain".

## 1010. Advanced Materials

### 1011. Equipment, Assemblies and Components

1. Components made from fluorinated compounds, as follows:
  - a. Seals, gaskets, sealants or fuel bladders specially designed for aircraft or aerospace use made from more than 50% of any of the materials embargoed by 1013.9.b. or c.;
  - b. Piezoelectric polymers and copolymers made from vinylidene fluoride:
    1. In sheet or film form; **and**
    2. With a thickness exceeding 200  $\mu\text{m}$ ;
  - c. Seals, gaskets, valve seats, bladders or diaphragms made from fluoroelestomers containing at least one vinyl ether monomer, specially designed for aircraft, aerospace or missile use;
2. "Composite" structures or laminates:
  - a. Having an organic "matrix" and made from materials embargoed by 1013.10.c., d. or e.; **or**
  - b. Having a metal or carbon "matrix" and made from:
    1. Carbon "fibrous or filamentary materials" with:
      - a. A specific modulus exceeding  $10.15 \times 10^6 \text{ m}$ ; **and**
      - b. A specific tensile strength exceeding  $17.7 \times 10^4 \text{ m}$ ; **or**
    2. Materials embargoed by 1013.10.c.;

### Technical Notes:

1. Specific modulus: Young's modulus in pascals, equivalent to  $\text{N/m}^2$  divided by specific weight in  $\text{N/m}^3$ , measured at a temperature of  $(296 \pm 2) \text{ K}$  ( $(23 \pm 2)^\circ\text{C}$ ) and a relative humidity of  $(50 \pm 5)\%$ .
2. Specific tensile strength: ultimate tensile strength in pascals, equivalent to  $\text{N/m}^2$  divided by specific weight in  $\text{N/m}^3$ , measured at a temperature of  $(296 \pm 2) \text{ K}$  ( $(23 \pm 2)^\circ\text{C}$ ) and a relative humidity of  $(50 \pm 5)\%$ .

### Note:

1011.2. does not embargo composite structures or laminates made from epoxy resin impregnated carbon "fibrous or filamentary materials" for the repair of aircraft structures or laminates, provided the size does not exceed  $1 \text{ m}^2$ .

3. Manufactures of non-fluorinated polymeric substances embargoed by 1013.8.a., in film, sheet, tape or ribbon form:
  - a. With a thickness exceeding 0.254 mm; **or**
  - b. Coated or laminated with carbon, graphite, metals or magnetic substances.

### 1012. Test, Inspection and Production Equipment

1. Equipment for the production of fibres, prepregs, preforms or "composites" embargoed by 1011.2 or 1013.10., as follows, and specially designed components and accessories 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 for the manufacture of "composite" structures or laminates from "fibrous or filamentary materials";
  - b. Tape-laying or tow-placement machines of which the motions for positioning and laying tape, tows or sheets are coordinated and programmed in two or more axes, specially designed for the manufacture of "composite" airframe or missile structures;
  - c. Multidirectional, multidimensional weaving machines or interlacing machines, including adapters and modification kits, for weaving, interlacing or braiding fibres to manufacture "composite" structures, **except** textile machinery not modified for the above end-uses;
  - d. Equipment specially designed or adapted for the production of reinforcement fibres, as follows:
    1. Equipment for converting polymeric fibres (such as polyacrylonitrile, rayon, pitch or polycarbosilane) into carbon fibres or silicon carbide fibres, including special equipment to strain the fibre during heating;
    2. Equipment for the chemical vapour deposition of elements or compounds on heated filamentary substrates to manufacture silicon carbide fibres;
    3. Equipment for the wet-spinning of refractory ceramics (such as aluminium oxide);
    4. Equipment for converting aluminium containing precursor fibres into alumina fibres by heat treatment;
  - e. Equipment for producing prepregs embargoed by 1013.10.e. by the hot melt method;
  - f. Non-destructive inspection equipment capable of inspecting defects three dimensionally, using ultrasonic or X-ray tomography and specially designed for "composite" materials;
2. Systems and components therefor specially designed for producing metal alloys, metal alloy powder or alloyed materials embargoed by 1013.2.a.2., 1013.2.b. or 1013.2.c.;
3. Tools, dies, moulds or fixtures, for "superplastic forming" or "diffusion bonding" titanium or aluminium or their alloys, specially designed for the manufacture of:
  - a. Airframe or aerospace structures;
  - b. Aircraft or aerospace engines; **or**
  - c. Specially designed components for those structures or engines.

### 1013. Materials

1. Materials specially designed for use as absorbers of electromagnetic waves, or intrinsically conductive polymers, as follows:
  - a. Materials for absorbing frequencies exceeding  $2 \times 10^8 \text{ Hz}$  but less than  $3 \times 10^{12} \text{ Hz}$ , **except** materials as follows:

### Note:

Nothing in 1013.1.a. releases magnetic materials to provide absorption when contained in paint.

1. Hair type absorbers, constructed of natural or synthetic fibres, with non-magnetic loading to provide absorption;
2. Absorbers having no magnetic loss and whose incident surface is non-planar in shape, including pyramids, cones, wedges and convoluted surfaces;
3. Planar absorbers:
  - a. Made from:

**Technical Note:**

Absorption test samples for 1013.1.a.3.a. should be a square at least 5 wavelengths of the centre frequency on a side and positioned in the far field of the radiating element.

1. a. 3. a. 1. Plastic foam materials (flexible or non-flexible) with carbon-loading, or organic materials, including binders, providing more than 5% echo compared with metal over a bandwidth exceeding  $\pm 15\%$  of the centre frequency of the incident energy, and not capable of withstanding temperatures exceeding 450 K (177°C); **or**
  2. Ceramic materials providing more than 20% echo compared with metal over a bandwidth exceeding  $\pm 15\%$  of the centre frequency of the incident energy, and not capable of withstanding temperatures exceeding 800 K (527°C);
- b. Tensile strength less than  $7 \times 10^6$  N/m<sup>2</sup>; **and**
- c. Compressive strength less than  $14 \times 10^6$  N/m<sup>2</sup>;
4. Planar absorbers made of sintered ferrite, with:
  - a. A specific gravity exceeding 4.4; **and**
  - b. A maximum operating temperature of 548 K (275°C);
- b. Materials for absorbing frequencies exceeding  $1.5 \times 10^{14}$  Hz but less than  $3.7 \times 10^{14}$  Hz and not transparent to visible light;
- c. Intrinsically conductive polymeric materials with a bulk electrical conductivity exceeding 10,000 S/m (Siemens per metre) or a sheet (surface) resistivity of less than 100 ohms/square, based on any of the following polymers:
  1. Polyaniline;
  2. Polypyrrole;
  3. Polythiophene;
  4. Poly phenylene-vinylene; **or**
  5. Poly thienylene-vinylene;

**Technical Note:**

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

2. Metal alloys, metal alloy powder or alloyed materials, as follows:

**Note:**

1013.2. does not embargo metal alloys, metal alloy powder or alloyed materials for coating substrates.

- a. Metal alloys, as follows:

1. Nickel or titanium-based alloys in the form of aluminides, as follows, in crude or semi-fabricated forms:
  - a. Nickel aluminides containing 10 weight percent or more aluminium;
  - b. Titanium aluminides containing 12 weight percent or more aluminium;
2. Metal alloys, as follows, made from metal alloy powder or particulate material embargoed by 1013.2.b.:
  - a. Nickel alloys with:
    1. A stress-rupture life of 10,000 hours or longer at 923 K (650°C) at a stress of 550 MPa; **or**
    2. A low cycle fatigue life of 10,000 cycles or more at 823 K (550°C) at a maximum stress of 700 MPa;
  - b. Niobium alloys with:
    1. A stress-rupture life of 10,000 hours or longer at 1,073 K (800°C) at a stress of 400 MPa; **or**
    2. A low cycle fatigue life of 10,000 cycles or more at 973 K (700°C) at a maximum stress of 700 MPa;
  - c. Titanium alloys with:
    1. A stress-rupture life of 10,000 hours or longer at 723 K (450°C) at a stress of 200 MPa; **or**
    2. A low cycle fatigue life of 10,000 cycles or more at 723 K (450°C) at a maximum stress of 400 MPa;
  - d. Aluminium alloys with a tensile strength of:
    1. 240 MPa or more at 473 K (200°C); **or**
    2. 415 MPa or more at 298 K (25°C);
  - e. Magnesium alloys with a tensile strength of 345 MPa or more and a corrosion rate of less than 1 mm/year in 3% sodium chloride aqueous solution measured in accordance with ASTM standard G-31 or national equivalents;

**Technical Notes:**

1. The metal alloys in 1013.2.a. are those containing a higher percentage by weight of the stated metal than of any other element.
2. Stress-rupture life should be measured in accordance with ASTM standard E-139 or national equivalents.
3. Low cycle fatigue life should be measured in accordance with ASTM Standard E-606 'Recommended Practice for Constant-Amplitude Low-Cycle Fatigue Testing' or national equivalents. Testing should be axial with an average stress ratio equal to 1 and a stress-concentration factor (K) equal to 1. The average stress is defined as maximum stress minus minimum stress divided by maximum stress.
- b. Metal alloy powder or particulate material for materials embargoed by 1013.2.a., as follows:

1. Made from any of the following composition systems:

**Technical Note:**

X in the following equals one or more alloying elements.

- a. Nickel alloys (Ni-Al-X, Ni-X-Al) qualified for turbine engine parts or components, i.e. with less than 3 non-metallic particles (introduced during the manufacturing process) larger than 100  $\mu$ m in 109 alloy particles;
- b. Niobium alloys (Nb-Al-X or Nb-X-Al, Nb-Si-X or Nb-X-Si, Nb-Ti-X or Nb-X-Ti);
- c. Titanium alloys (Ti-Al-X or Ti-X-Al);
- d. Aluminium alloys (Al-Mg-X or Al-X-Mg, Al-Zn-X or Al-X-Zn, Al-Fe-X or Al-X-Fe); **or**
- e. Magnesium alloys (Mg-Al-X or Mg-X-Al); **and**
2. Made in a controlled environment by any of the following processes:
  - a. "Vacuum atomization";
  - b. "Gas atomization";
  - c. "Rotary atomization";
  - d. "Splat quenching";
  - e. "Melt spinning" and "comminution";
  - f. "Melt extraction" and "comminution"; **or**
  - g. "Mechanical alloying";
- c. Alloyed materials, in the form of uncomminuted flakes, ribbons or thin rods produced in a controlled environment by "splat quenching," "melt spinning" or "melt extraction", used in the manufacture of metal alloy powder or particulate material embargoed by 1013.2.b.;
3. Magnetic metals, of all types and of whatever form, having any of the following characteristics:

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

**Technical Note:**

Measurement of initial permeability must be performed on fully annealed materials.

- b. Magnetostrictive alloys with:
  1. A saturation magnetostriction of more than  $5 \times 10^{-4}$ ; **or**
  2. A magnetomechanical coupling factor (k) of more than 0.8; **or**
- c. Amorphous alloy strips with:
  1. A composition having a minimum of 75 weight percent of iron, cobalt or nickel; **and**
  2. A saturation magnetic induction ( $B_s$ ) of 1.6 T or more, **and**
    - a. A strip thickness of 0.02 mm or less; **or**
    - b. An electrical resistivity of  $2 \times 10^{-4}$  ohm cm or more;
4. Uranium titanium alloys or tungsten alloys with a "matrix" based on iron, nickel or copper, with:
  - a. A density exceeding 17.5 g/cm<sup>3</sup>;
  - b. An elastic limit exceeding 1,250 MPa;
  - c. An ultimate tensile strength exceeding 1,270 MPa; **and**
  - d. An elongation exceeding 8%;
5. "Superconductive" "composite" conductors in lengths exceeding 100 m or with a mass exceeding 100 g, as follows:
  - a. Multifilamentary "superconductive" "composite" conductors containing one or more niobium-titanium filaments:
    1. Embedded in a "matrix" other than a copper or copper-based mixed "matrix"; **or**
    2. With a cross-section area less than  $0.28 \times 10^{-4}$  mm<sup>2</sup> (6  $\mu$ m in diameter for circular filaments);
  - b. "Superconductive" "composite" conductors consisting of one or more "superconductive" filaments other than niobium-titanium;

**1013. cont'd.**

5. b. 1. With a "critical temperature" at zero magnetic induction exceeding 9.85 K (-263.31°C) but less than 24 K (-249.16°C);
2. With a cross-section area less than  $0.28 \times 10^{-4} \text{ mm}^2$ ; **and**
3. Which remain in the "superconductive" state at a temperature of 4.2 K (-268.96°C) when exposed to a magnetic field corresponding to a magnetic induction of 12 T;
6. Fluids and lubricating materials, as follows:
  - a. Hydraulic fluids containing, as their principal ingredients, any of the following compounds or materials:
    1. Synthetic hydrocarbon oils or silahydrocarbon oils with:
 

**Note:**  
For the purpose of 1013.6.a.1., silahydrocarbon oils contain exclusively silicon, hydrogen and carbon.

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

**Note:**  
For the purpose of 1013.6.a.2., chlorofluorocarbons contain exclusively carbon, fluorine and chlorine.

      - a. No flash point;
      - b. An autogenous ignition temperature exceeding 977 K (704°C);
      - c. A pour point at 219 K (-54°C) or less;
      - d. A viscosity index of 80 or more; **and**
      - e. A boiling point at 473 K (200°C) or higher;
  - b. Lubricating materials containing, as their principal ingredients, any of the following compounds or materials:
    1. Phenylene or alkylphenylene ethers or thio-ethers, or their mixtures, containing more than two ether or thio-ether functions or mixtures thereof; **or**
    2. Fluorinated silicone fluids with a kinematic viscosity of less than  $5,000 \text{ mm}^2/\text{s}$  (5,000 centistokes) measured at 298 K (25°C);
  - c. Damping or flotation fluids with a purity exceeding 99.8%, containing less than 25 particles of 200  $\mu\text{m}$  or larger in size per 100 ml and made from at least 85% of any of the following compounds or materials:
    1. Dibromotetrafluoroethane;
    2. Polychlorotrifluoroethylene (oily and waxy modifications only); **or**
    3. Polybromotrifluoroethylene;

**Technical Note:**  
For the purpose of 1013.6.:

  - a. Flash point is determined using the Cleveland Open Cup Method described in ASTM D-92 or national equivalents.
  - b. Pour point is determined using the method described in ASTM D-97 or national equivalents.
  - c. Viscosity index is determined using the method described in ASTM D-2270 or national equivalents.
  - d. Thermal stability is determined by the following test procedure or national equivalents:  
Twenty ml of the fluid under test is placed in a 46 ml type 317 stainless steel chamber containing one each of 12.5 mm (nominal) diameter balls of M-10 tool steel, 52100 steel and naval bronze (60% Cu, 39% Zn, 0.75% Sn).  
The chamber is purged with nitrogen, sealed at atmospheric pressure and the temperature raised to and maintained at  $644 \pm 6 \text{ K}$  ( $371 \pm 6^\circ\text{C}$ ) for six hours.  
The specimen will be considered thermally stable if, on completion of the above procedure, all of the following conditions are met:
    1. The loss in weight of each ball is less than  $10 \text{ mg/mm}^2$  of ball surface;
    2. The change in original viscosity as determined at 311 K (38°C) is less than 25%; **and**
    3. The total acid or base number is less than 0.40.
  - e. Autogenous ignition temperature is determined using the method described in ASTM E-659 or national equivalents.
7. Ceramic base materials, non-"composite" ceramic materials, ceramic-"matrix" "composite" materials and precursor materials, as follows:
  - a. Base materials of single or complex borides of titanium having total metallic impurities, excluding intentional additions, of less than 5,000 ppm, an average particle size equal to or less than 5  $\mu\text{m}$  and no more than 10% of the particles larger than 10  $\mu\text{m}$ ;

- b. Non-"composite" ceramic materials in crude or semi-fabricated form, **except** abrasives, composed of borides of titanium with a density of 98% or more of the theoretical density;
- c. Ceramic-ceramic "composite" materials with a glass or oxide-"matrix" and reinforced with fibres from any of the following systems:
  1. Si-N;
  2. Si-C;
  3. Si-Al-O-N; **or**
  4. Si-O-N;
- d. Ceramic-ceramic "composite" materials, with or without a continuous metallic phase, containing finely dispersed particles or phases of any fibrous or whisker-like material, where carbides or nitrides of silicon, zirconium or boron form the "matrix";
- e. Precursor materials (i.e. special purpose polymeric or metallo-organic materials) for producing any phase or phases of the materials embargoed by 1013.7.c., as follows:
  1. Polydiorganosilanes (for producing silicon carbide);
  2. Polysilazanes (for producing silicon nitride);
  3. Polycarbosilazanes (for producing ceramics with silicon, carbon and nitrogen components);
8. Non-fluorinated polymeric substances, as follows:
  - a. 1. Bismaleimides;
  2. Aromatic polyamide-imides;
  3. Aromatic polyimides;
  4. Aromatic polyetherimides having a glass transition temperature ( $T_g$ ) exceeding 503 K (230°C) as measured by the wet method;

**Note:**  
1013.8.a. does not embargo non-fusible compression moulding powders or moulded forms.

  - b. Thermoplastic liquid crystal copolymers having a heat distortion temperature exceeding 523 K (250°C) measured according to ASTM D-648, method A, or national equivalents, with a load of 1.82 N/mm<sup>2</sup> and composed of:
    1. Either of the following:
      - a. Phenylene, biphenylene or naphthalene; **or**
      - b. Methyl, tertiary-butyl or phenyl substituted phenylene, biphenylene or naphthalene; **and**
    2. Any of the following acids:
      - a. Terephthalic acid;
      - b. 6-hydroxy-2 naphthoic acid; **or**
      - c. 4-hydroxybenzoic acid;
  - c. Polyarylene ether ketones, as follows:
    1. Polyether ether ketone (PEEK);
    2. Polyether ketone ketone (PEKK);
    3. Polyether ketone (PEK);
    4. Polyether ketone ether ketone ketone (PEKEKK);
  - d. Polyarylene ketones;
  - e. Polyarylene sulphides, where the arylene group is biphenylene, triphenylene or combinations thereof;
  - f. Polybiphenylenethersulphone;
9. Unprocessed fluorinated compounds, as follows:
  - a. Copolymers of vinylidene fluoride having 75% or more beta crystalline structure without stretching;
  - b. Fluorinated polyimides containing 30% or more of combined fluorine;
  - c. Fluorinated phosphazene elastomers containing 30% or more of combined fluorine;
10. "Fibrous and filamentary materials" which may be used in organic "matrix", metallic "matrix" or carbon "matrix" "composite" structures or laminates, as follows:
  - a. Organic "fibrous or filamentary materials" (**except** polyethylene) with:
    1. A specific modulus exceeding  $12.7 \times 10^6 \text{ m}$ ; **and**
    2. A specific tensile strength exceeding  $23.5 \times 10^4 \text{ m}$ ;
  - b. Carbon "fibrous or filamentary materials" with:
    1. A specific modulus exceeding  $12.7 \times 10^6 \text{ m}$ ; **and**
    2. A specific tensile strength exceeding  $23.5 \times 10^4 \text{ m}$ ;

**Technical Note:**

Properties for materials described in 1013.10.b. should be determined using SACMA recommended methods SRM 12 to 17, or national equivalent tow tests, such as Japanese Industrial Standard JIS-R-7601, Paragraph 6.6.2., and based on lot average.

**Note:**

1013.10.b. does not embargo fabric made from "fibrous or filamentary materials" for the repair of aircraft structures or laminates, in which the size of individual sheets does not exceed 50 cm x 90 cm.

## c. Inorganic "fibrous or filamentary materials" with:

1. A specific modulus exceeding  $2.54 \times 10^6$  m; **and**
2. A melting, decomposition or sublimation point exceeding 1,922 K (1,649°C) in an inert environment;

**Note:**

1013.10.c. does not embargo:

1. Discontinuous, multiphase, polycrystalline alumina fibres in chopped fibre or random mat form, containing 3 weight percent or more silica, with a specific modulus of less than  $10 \times 10^6$  m;
2. Molybdenum and molybdenum alloy fibres;
3. Boron fibres;
4. Discontinuous ceramic fibres with a melting, decomposition or sublimation point lower than 2,043 K (1,770°C) in an inert environment.

## d. "Fibrous or filamentary materials":

1. Composed of any of the following:
    - a. Polyetherimides embargoed by 1013.8.a; **or**
    - b. Materials embargoed by 1013.8.b., c., d., e. or f.; **or**
  2. Composed of materials embargoed by 1013.10.d.1.a. or b. and "commingled" with other fibres embargoed by 1013.10.a., b. or c.;
- e. Resin- or pitch-impregnated fibres (prepregs), metal or carbon-coated fibres (preforms) or "carbon fibre preforms", as follows:
1. Made from "fibrous or filamentary materials" embargoed by 1013.10.a., b. or c.;
  2. Made from organic or carbon "fibrous or filamentary materials":
    - a. With a specific tensile strength exceeding  $17.7 \times 10^4$  m;
    - b. With a specific modulus exceeding  $10.15 \times 10^6$  m;
    - c. Not embargoed by 1013.10.a. or b.; **and**
    - d. When impregnated with materials embargoed by 1013.8. or 1013.9.b., or with phenolic or epoxy resins, having a glass transition temperature ( $T_g$ ) exceeding 383 K (110°C);

**Note:**

1013.10.e. does not embargo epoxy resin matrix impregnated carbon "fibrous or filamentary materials" (prepregs) for the repair of aircraft structures or laminates, in which the size of individual sheets of prepreg does not exceed 50 cm x 90 cm.

**Technical Notes**

1. Specific modulus: Young's modulus in pascals, equivalent to  $N/m^2$  divided by specific weight in  $N/m^3$ , measured at a temperature of  $(296 \pm 2)$  K  $(23 \pm 2)^\circ\text{C}$  and a relative humidity of  $(50 \pm 5)\%$ .
2. Specific tensile strength: ultimate tensile strength in pascals, equivalent to  $N/m^2$  divided by specific weight in  $N/m^3$ , measured at a temperature of  $(296 \pm 2)$  K  $(23 \pm 2)^\circ\text{C}$  and a relative humidity of  $(50 \pm 5)\%$ .

(See Technical Note 2 to the Atomic Energy List.)

**1014. Software**

1. "Software" specially designed or modified for the "development", "production" or "use" of equipment embargoed by 1012.;
2. "Software" for the "development" of organic "matrix", metal "matrix" or carbon "matrix" laminates or "composites".

**1015. Technology**

1. Technology according to the General Technology Note for the "development" or "production" of equipment or materials embargoed by 1011.1.b., 1011.1.c., 1011.2., 1011.3., 1012. or 1013.;
2. Other technology:
  - a. Technology for the "development" or "production" of polybenzothiazoles or polybenzoxazoles;
  - b. Technology for the "development" or "production" of fluoroelastomer compounds containing at least one vinyl ether monomer;
  - c. Technology for the design or "production" of the following base materials or non-"composite" ceramic materials
    1. Base materials having all of the following characteristics:

## a. Any of the following compositions:

1. Single or complex oxides of zirconium and complex oxides of silicon or aluminium;
2. Single nitrides of boron (cubic crystalline forms);
3. Single or complex carbides of silicon or boron; **or**
4. Single or complex nitrides of silicon;

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

1. 1,000 ppm for single oxides or carbides; **or**
  2. 5,000 ppm for complex compounds or single nitrides; **and**
- c. 1. Average particle size equal to or less than 5  $\mu\text{m}$  and no more than 10% of the particles larger than 10  $\mu\text{m}$ ; **or**

**Note:**

For zirconia, these limits are 1  $\mu\text{m}$  and 5  $\mu\text{m}$  respectively;

- a. Platelets with a length to thickness ratio exceeding 5;
- b. Whiskers with a length to diameter ratio exceeding 10 for diameters less than 2  $\mu\text{m}$ ; **and**
- c. Continuous or chopped fibres less than 10  $\mu\text{m}$  in diameter;

2. Non-"composite" ceramic materials (**except** abrasives) composed of the materials described in 1015.2.c.1.;

- d. Technology for the "production" of aromatic polyamide fibres;
- e. Technology for the installation, maintenance or repair of materials embargoed by 1013.1.;
- f. Technology for the repair of "composite" structures, laminates or materials embargoed by 1011.2., 1013.7.c. or 1013.7.d.

**Note:**

1015.2.f. does not embargo technology for the repair of "civil aircraft" structures using carbon "fibrous or filamentary materials" and epoxy resins, contained in aircraft manufacturers' manuals.

**1020. Materials Processing****1021. Equipment, Assemblies and Components**

Anti-friction bearings or bearing systems, as follows, and components therefor:

**Note**

1021. does not embargo balls with tolerances specified by the manufacturer in accordance with ISO 3290 as grade 5 or worse.

1. Ball bearings or solid roller bearings (except tapered roller bearings) having tolerances specified by the manufacturer in accordance with ABEC 7, ABEC 7P, ABEC 7T or ISO Standard Class 4 or better (or national equivalents), and having any of the following characteristics:
  - a. Rings, balls or rollers made from monel or beryllium;
  - b. Manufactured for use at operating temperatures above 573 K (300°C) either by using special materials or by special heat treatment; **or**
  - c. With lubricating elements or component modifications that, according to the manufacturer's specifications, are specially designed to enable the bearings to operate at speeds exceeding 2.3 million DN;
2. Other ball bearings or solid roller bearings (except tapered roller bearings) having tolerances specified by the manufacturer in accordance with ABEC 9, ABEC 9P or ISO Standard Class 2 or better (or national equivalents);
3. Solid tapered roller bearings, having tolerances specified by the manufacturer in accordance with ANSI/AFBMA Class 00 (inch) or Class A (metric) or better (or national equivalents) and having either of the following characteristics:
  - a. With lubricating elements or component modifications that, according to the manufacturer's specifications, are specially designed to enable the bearings to operate at speeds exceeding 2.3 million DN; **or**
  - b. Manufactured for use at operating temperatures below 219 K (-54°C) or above 423 K (150°C);
4. Gas-lubricated foil bearings manufactured for use at operating temperatures of 561 K (288°C) or higher and with a unit load capacity exceeding 1 MPa;
5. Active magnetic bearing systems;
6. Fabric-lined self-aligning or fabric-lined journal sliding bearings manufactured for use at operating temperatures below 219 K (-54°C) or above 423 K (150°C).

**Technical Notes**

1.  $DN$  is the product of the bearing bore diameter in mm and the bearing rotational velocity in rpm.

2. Operating temperatures include those temperatures obtained when a gas turbine engine has stopped after operation.  
(For quiet running bearings, see Item 2009 on the Munitions List.)

## 1022. Test, Inspection and Production Equipment

### Note

1022. does not embargo measuring interferometer systems, without closed or open loop feedback, containing a "laser" to measure slide movement errors of machine-tools, dimensional inspection machines or similar equipment.

1. "Numerical control" units, "motion control boards" specially designed for "numerical control" applications on machine tools, machine tools, and specially designed components therefor, as follows:

### Technical Notes

1. Secondary parallel contouring axes, e.g. the w-axis on horizontal boring mills or a secondary rotary axis the centre line of which is parallel to the primary rotary axis, are not counted in the total number of contouring axes.

### N.B.:

Rotary axes need not rotate over 360°. A rotary axis can be driven by a linear device, e.g. a screw or a rack-and-pinion.

2. Axis nomenclature shall be in accordance with International Standard ISO 841, 'Numerical Control Machines - Axis and Motion Nomenclature'.

1. a. "Numerical control" units for machine tools, as follows, and specially designed components therefor:

### Note:

1022.1.a. does not embargo "numerical control" units:

1. Modified for and incorporated in unembargoed machines; **or**  
2. Specially designed for unembargoed machines.

1. a. 1. Having more than four interpolating axes which can be coordinated simultaneously for "contouring control";  
2. Having two, three or four interpolating axes which can be coordinated simultaneously for "contouring control" and:  
a. Capable of "real time processing" of data to modify, during the machining operation, tool path, feed rate and spindle data by either:  
1. Automatic calculation and modification of part programme data for machining in two or more axes by means of measuring cycles and access to source data; **or**  
2. "Adaptive control" with more than one physical variable measured and processing by means of a computing model (strategy) to change one or more machining instructions to optimize the process;  
b. Capable of receiving directly (on-line) and processing computer aided design (CAD) data for internal preparation of machine instructions; **or**  
c. Capable, without modification, according to the manufacturer's technical specifications, of accepting additional boards which would permit an increase above the embargo levels specified in 1022.1., in the number of interpolating axes which can be coordinated simultaneously for "contouring control", even if they do not contain these additional boards;
1. b. "Motion control boards" specially designed for machine tools and having any of the following characteristics:  
1. Interpolation in more than four axes;  
2. Capable of "real time processing" as described in 1022.1.a.2.a.; **or**  
3. Capable of receiving and processing CAD data as described in 1022.1.a.2.b.;
1. c. Machine tools, as follows, for removing or cutting metals, ceramics or composites, which, according to the manufacturer's technical specifications, can be equipped with electronic devices for simultaneous "contouring control" in two or more axes:  
1. Machine tools for turning, grinding, milling or any combination thereof which:  
a. Have two or more axes which can be coordinated simultaneously for "contouring control"; **and**  
b. Have any of the following characteristics:  
1. Two or more contouring rotary axes;

### Technical Note

The c axis on jig grinders used to maintain grinding wheels normal to the work surface is not considered a contouring rotary axis.

2. One or more contouring "tilting spindles";

### Note:

1022.1.c.1.b.2. applies to machine tools for grinding or milling only.

3. "Camming" (axial displacement) in one revolution of the spindle less (better) than 0.0006 mm total indicator reading (TIR);

### Note:

1022.1.c.1.b.3. applies to machine tools for turning only.

4. "Run out" (out-of-true running) in one revolution of the spindle less (better) than 0.0006 mm TIR;  
5. The positioning accuracies, with all compensations available, are less (better) than:  
a. 0.001" on any rotary axis; **or**  
b. 1. 0.004 mm along any linear axis (overall positioning) for grinding machines;  
2. 0.006 mm along any linear axis (overall positioning) for turning or milling machines; **or**

### Note:

1022.1.c.1.b.5. does not embargo milling or turning machine tools with a positioning accuracy along one axis, with all compensations available, equal to or more (worse) than 0.005 mm.

### Technical Note

The positioning accuracy of "numerically controlled" machine tools is to be determined and presented in accordance with ISO/DIS 230/2, paragraph 2.13, in conjunction with the requirements below:

- a. Test conditions (paragraph 3):  
1. For 12 hours before and during measurements, the machine tool and accuracy measuring equipment will be kept at the same ambient temperature. During the premeasurement time the slides of the machine will be continuously cycled in the same manner that the accuracy measurements will be taken;  
2. The machine shall be equipped with any mechanical, electronic, or software compensation to be exported with the machine;  
3. Accuracy of measuring equipment for the measurements shall be at least four times more accurate than the expected machine tool accuracy;  
4. Power supply for slide drives shall be as follows:  
a. Line voltage variation shall not exceed  $\pm 10\%$  of nominal rated voltage;  
b. Frequency variation shall not exceed  $\pm 2$  Hz of normal frequency;  
c. Lineouts or interrupted service are not permitted;
- b. Test programme (paragraph 4):  
1. Feed rate (velocity of slides) during measurement shall be the rapid traverse rate;  
**N.B.:**  
In the case of machines tools which generate optical quality surfaces, the feed rate shall be equal to or less than 50 mm per minute.  
2. Measurements shall be made in an incremental manner from one limit of the axis travel to the other without returning to the starting position for each move to the target position;  
3. Axes not being measured shall be retained at mid travel during test of an axis;
- c. Presentation of test results (paragraph 2):  
The results of the measurements must include:

1. c. 1. b. 6. a. A positioning accuracy less (better) than 0.007 mm; **and**
- b. A slide motion from rest for all slides within 20% of a motion command input for inputs of less than 0.5 µm;

**Technical Note**

Minimum increment of motion test (slide motion from rest):  
The test is conducted only if the machine tool is equipped with a control unit the minimum increment of which is less (better) than 0.5 µm.

Prepare the machine for testing in accordance with ISO 230/2 paragraphs 3.1, 3.2, 3.3.

Conduct the test on each axis (slide) of the machine tool as follows:

- a. Move the axis over at least 50% of the maximum travel in plus and minus directions twice at maximum feed rate, rapid traverse rate or jog control;
- b. Wait at least 10 seconds;
- c. With manual data input, input the minimum programmable increment of the control unit;
- d. Measure the axis movement;
- e. Clear the control unit with the servo null, reset or whatever clears any signal (voltage) in the servo loop;
- f. Repeat steps 2 to 5 five times, twice in the same direction of the axis travel and three times in the opposite direction of travel for a total of six test points;
- g. If the axis movement is between 80% and 120% of the minimum programmable input for four of the six test points, the machine is embargoed.

For rotary axes, the measurement is taken 200 mm from the centre of rotation.

**Notes**

1. 1022.1.c.1. does not embargo cylindrical external, internal, and external-internal grinding machines having all of the following characteristics:
  - a. Not centreless (shoe-type) grinding machines;
  - b. Limited to cylindrical grinding;
  - c. A maximum workpiece capacity of 150 mm outside diameter or length;
  - d. Only two axes which can be coordinated simultaneously for "contouring control"; **and**
  - e. No contouring c axis.
2. 1022.1.c.1. does not embargo machines designed specifically as jig grinders having both of the following characteristics:
  - a. Axes limited to x, y, c and a, where the c axis is used to maintain the grinding wheel normal to the work surface and the a axis is configured to grind barrel cams; **and**
  - b. A spindle "run out" not less (not better) than 0.0006 mm.
3. 1022.1.c.1. does not embargo tool or cutter grinding machines having all of the following characteristics:
  - a. Shipped as a complete system with "software" specially designed for the production of tools or cutters;
  - b. No more than two rotary axes which can be coordinated simultaneously for "contouring control";
  - c. "Run out" (out-of-true running) in one revolution of the spindle not less (not better) than 0.0006 mm TIR; **and**
  - d. The positioning accuracies, with all compensations available, are not less (not better) than:
    1. 0.004 mm along any linear axis for overall positioning; **or**
    2. 0.001° on any rotary axis.
1. c. 2. Electrical discharge machines (EDM) of the wire feed type which have five or more axes which can be coordinated simultaneously for "contouring control";
3. Electrical discharge machines (EDM) of the non-wire type which have two or more rotary axes which can be coordinated simultaneously for "contouring control";
4. Machine tools for removing metals, ceramics or composites:
  - a. By means of:

1. Water or other liquid jets, including those employing abrasive additives;
2. Electron beam; **or**
3. "Laser" beam; **and**
- b. Having two or more rotary axes which:
  1. Can be coordinated simultaneously for "contouring control"; **and**
  2. Have a positioning accuracy of less (better) than 0.003°;

**Technical Note**

Machines capable of being simultaneously coordinated for "contouring control", in two or more rotary axes or one or more tilting spindles, remain embargoed regardless of the number of simultaneously coordinated contouring axes that can be controlled by the "numerical control" unit attached to the machine.

2. Non-"numerically controlled" machine tools for generating optical quality surfaces, as follows:
  - a. Turning machines using a single point cutting tool and having all of the following characteristics:
    1. Slide positioning accuracy less (better) than 0.0005 mm per 300 mm of travel;
    2. Bidirectional slide positioning repeatability less (better) than 0.00025 mm per 300 mm of travel;
    3. Spindle "run out" and "camming" less (better) than 0.0004 mm TIR;
    4. Angular deviation of the slide movement (yaw, pitch and roll) less (better) than 2 seconds of arc, TIR, over full travel; **and**
    5. Slide perpendicularity less (better) than 0.001 mm per 300 mm of travel;
  - b. Fly cutting machines having both of the following characteristics:
    1. Spindle "run out" and "camming" less (better) than 0.0004 mm TIR; **and**
    2. Angular deviation of slide movement (yaw, pitch and roll) less (better) than 2 seconds of arc, TIR, over full travel;
  3. "Numerically controlled" or manual machine tools specially designed for cutting, finishing, grinding or honing either of the following classes of bevel or parallel axis hardened ( $R_c = 40$  or more) gears, and specially designed components, controls and accessories therefor:
    - a. Hardened bevel gears finished to a quality of better than AGMA 13 (equivalent to ISO 1328 class 4); **or**
    - b. Hardened spur, helical and double-helical gears with a pitch diameter exceeding 1,250 mm and a face width of 15% of pitch diameter or larger finished to a quality of AGMA 14 or better (equivalent to ISO 1328 class 3);
  4. Hot "isostatic presses", as follows, and specially designed dies, moulds, components, accessories and controls therefor:
    - a. Having a controlled thermal environment within the closed cavity and possessing a chamber cavity with an inside diameter of 406 mm or more; **and**
    - b. Having:
      1. A maximum working pressure exceeding 207 MPa;
      2. A controlled thermal environment exceeding 1,773 K (1,500°C); **or**
      3. A facility for hydrocarbon impregnation and removal of resultant gaseous degradation products;

**Technical Note**

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

5. Equipment specially designed for the deposition, processing and in-process control of inorganic overlays, coatings and surface modifications, as follows, for non-electronic substrates, by processes shown in the Table and associated Notes following 1025.3.d, and specially designed automated handling, positioning, manipulation and control components therefor:
  - a. "Stored programme controlled" chemical vapour deposition (CVD) production equipment with both of the following:
    1. Process modified for one of the following:

1022. cont'd.

- a. Pulsating CVD;
- b. Controlled nucleation thermal decomposition (CNTD); **or**
- c. Plasma enhanced or plasma assisted CVD; **and**
2. Either of the following:
  - a. Incorporating high vacuum (equal to or less than 0.01 Pa) rotating seals; **or**
  - b. Incorporating in situ coating thickness control;
- b. "Stored programme controlled" ion implantation production equipment having beam currents of 5 mA or more;
- c. "Stored programme controlled" electron beam physical vapour deposition (EB-PVD) production equipment incorporating:
  1. Power systems rated for over 80 kW;
  2. A liquid pool level "laser" control system which regulates precisely the ingots feed rate; **and**
  3. 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 either of the following characteristics:
  1. Operating at reduced pressure controlled atmosphere (equal to or less than 10 kPa measured above and within 300 mm of the gun nozzle exit) in a vacuum chamber capable of evacuation down to 0.01 Pa prior to the spraying process; **or**
  2. Incorporating in situ coating thickness control;
- e. "Stored programme controlled" sputter deposition production equipment capable of current densities of 0.1 mA/mm<sup>2</sup> or higher at a deposition rate of 15 µm/hr or more;
- f. "Stored programme controlled" cathodic arc deposition production equipment incorporating a grid of electromagnets for steering control of the arc spot on the cathode;
- g. "Stored programme controlled" ion plating production equipment allowing for the in situ measurement of either:
  1. Coating thickness on the substrate and rate control; **or**
  2. Optical characteristics;

**Note:**

1022.5.g. does not embargo standard ion plating coating equipment for cutting or machining tools.

6. Dimensional inspection or measuring systems or equipment, as follows:
  - a. Computer controlled, "numerically controlled" or "stored programme controlled" dimensional inspection machines, having both of the following characteristics:
    1. Two or more axes; **and**
    2. A one dimensional length "measurement uncertainty" equal to or less (better) than  $(1.25 + L/1,000)$  µm tested with a probe with an "accuracy" of less (better) than 0.2 µm (L is the measured length in mm);
  - b. Linear and angular displacement measuring instruments, as follows:
    1. Linear measuring instruments having any of the following characteristics:
      - a. Non-contact type measuring systems with a "resolution" equal to or less (better) than 0.2 µm within a measuring range up to 0.2 mm;
      - b. Linear voltage differential transformer systems with both of the following characteristics:
        1. "Linearity" equal to or less (better) than 0.1% within a measuring range up to 5 mm; **and**
        2. Drift equal to or less (better) than 0.1% per day at a standard ambient test room temperature ±1 K; **or**
    - c. Measuring systems having both of the following characteristics:
      1. Containing a "laser"; **and**
      2. Maintaining, for at least 12 hours, over a temperature range of ±1 K around a standard temperature and at a standard pressure:
        - a. A "resolution" over their full scale of 0.1 µm or less (better); **and**
        - b. A "measurement uncertainty" equal to or less (better) than  $(0.2 + L/2,000)$  µm (L is the measured length in mm);

2. Angular measuring instruments having an "angular position deviation" equal to or less (better) than 0.00025°;

**Note:**

1022.6.b.2. does not embargo optical instruments, such as autocollimators, using collimated light to detect angular displacement of a mirror.

- c. Systems for simultaneous linear-angular inspection of hemishells, having both of the following characteristics:
  1. "Measurement uncertainty" along any linear axis equal to or less (better) than 3.5 µm per 5 mm; **and**
  2. "Angular position deviation" equal to or less (better) than 0.02°;
- d. Equipment for measuring surface irregularities, by measuring optical scatter as a function of angle, with a sensitivity of 0.5 nm or less (better);

**Technical Notes**

1. The probe used in determining the "measurement uncertainty" of a dimensional inspection system shall be as described in VDI/VDE 2617 Parts 2, 3 and 4.
2. All measurement values in 1022.6. represent permissible positive and negative deviations from the target value, i.e. not total band.

**Notes**

1. Machine tools which can be used as measuring machines are embargoed if they meet or exceed the criteria specified for the machine tool function or the measuring machine function.
2. A machine described in 1022.6. is embargoed if it exceeds the embargo threshold anywhere within its operating range.

7. "Robots", as follows, and specially designed controllers and "end-effectors" therefor:

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

**Note:**

The scene analysis limitation does not include approximation of the third dimension by viewing at a given angle, or limited grey scale interpretation for the perception of depth or texture for the approved tasks (2 1/2 D).

- b. Specially designed to comply with national safety standards applicable to explosive munitions environments; **or**
- c. Specially designed or rated as radiation-hardened beyond that necessary to withstand normal industrial (i.e. non-nuclear industry) ionizing radiation;
8. Assemblies, units or inserts specially designed for machine tools, or for equipment embargoed by 1022.6. or 7., as follows:
  - a. Spindle assemblies, consisting of spindles and bearings as a minimal assembly, with radial ("run out") or axial ("camming") axis motion in one revolution of the spindle less (better) than 0.0006 mm TIR;
  - b. Linear position feedback units (e.g. inductive type devices, graduated scales, infrared systems or "laser" systems) having an overall "accuracy" less (better) than  $(800 + (600 \times L \times 10^{-3}))$  nm (L equals the effective length in mm);
  - c. Rotary position feedback units, e.g. inductive type devices, graduated scales, infrared systems or "laser" systems, having an "accuracy" less (better) than 0.00025°;
  - d. Slide way assemblies consisting of a minimal assembly of ways, bed and slide having all of the following characteristics:
    1. A yaw, pitch or roll of less (better) than 2 seconds of arc TIR (reference: ISO/DIS 230/1) over full travel;
    2. A horizontal straightness of less (better) than 2 µm per 300 mm length; **and**
    3. A vertical straightness of less (better) than 2 µm per 300 mm length;
  - 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 from 0.1 to 5 mm inclusive; **and**
    3. Cutting radius out-of-roundness less (better) than 0.002 mm TIR;
9. Specially designed printed circuit boards with mounted components and "software" therefor, or "compound rotary tables" or "tilting spindles", capable of upgrading, according to the manufacturer's specifications, "numerical control" units, machine tools or feed-back devices to or above the levels specified in 1022.

### 1023. Materials

None.

### 1024. Software

1. "Software" specially designed or modified for the "development", "production" or "use" of equipment embargoed by 1021. or 1022.;
2. Specific "software", as follows:
  - a. "Software" to provide "adaptive control" and having both of the following characteristics:
    1. For "flexible manufacturing units" (FMUs) which consist at least of equipment described in b.1. and b.2. of the definition of "flexible manufacturing unit"; **and**
    2. Capable of generating or modifying, in "real time processing", "programmes" or data by using the signals obtained simultaneously by means of at least two detection techniques, such as:
      - a. Machine vision (optical ranging);
      - b. Infrared imaging;
      - c. Acoustical imaging (acoustical ranging);
      - d. Tactile measurement;
      - e. Inertial positioning;
      - f. Force measurement;
      - g. Torque measurement;

**Note:**

1024.2.a. does not embargo "software" which only provides rescheduling of functionally identical equipment within "flexible manufacturing units" using pre-stored part programmes and a pre-stored strategy for the distribution of the part programmes.

- b. "Software" for electronic devices other than those described in 1022.1.a. or b., which provides the "numerical control" capability of the equipment embargoed by 1022.1.

**Note:**

1022.1. and 1024.2. embargo any combination of electronic devices or systems that collectively contain software enabling such devices or systems to function as a CNC capable of coordinating simultaneously more than 4 axes for "contouring control".

### 1025. Technology

1. Technology according to the General Technology Note for the "development" of equipment or "software" embargoed by 1021., 1022. or 1024.;
2. Technology according to the General Technology Note for the "production" of equipment embargoed by 1021. or 1022.;
3. Other technology, as follows:
  - a. Technology:
    1. For the "development" of interactive graphics as an integrated part in "numerical control" units for preparation or modification of part programmes;
    2. For the "development" of generators of machine tool instructions (e.g. part programmes) from design data residing inside "numerical control" units;
    3. For the "development" of integration "software" for incorporation of expert systems for advanced decision support of shop floor operations into "numerical control" units;
  - b. Technology for metal-working manufacturing processes, as follows:
    1. Technology for the design of tools, dies or fixtures specially designed for the following processes:
      - a. "Superplastic forming";
      - b. "Diffusion bonding";
      - c. "Direct-acting hydraulic pressing";
    2. Technical data consisting of process methods or parameters as listed below used to control:
      - a. "Superplastic forming" of aluminium alloys, titanium alloys or "superalloys":
        1. Surface preparation;
        2. Strain rate;
        3. Temperature;
        4. Pressure;
      - b. "Diffusion bonding" of "superalloys" or titanium alloys:
        1. Surface preparation;

2. Temperature;
  3. Pressure;
- c. "Direct-acting hydraulic pressing" of aluminium alloys or titanium alloys:
    1. Pressure;
    2. Cycle time;
  - d. "Hot isostatic densification" of titanium alloys, aluminium alloys or "superalloys":
    1. Temperature;
    2. Pressure;
    3. Cycle time;
- c. Technology for the "development" or "production" of hydraulic stretch-forming machines and dies therefor, for the manufacture of airframe structures;
  - d. Technology for:

The application of inorganic overlay coatings or inorganic surface modification coatings, specified in column 3 of the following Table of Deposition Techniques ;

    - a. to non-electronic substrates, specified in column 2 of the following Table;
    - b. by processes specified in column 1 of the following Table and defined in the Technical Note;
- d. Technology for:

The application of inorganic overlay coatings or inorganic surface modification coatings, specified in column 3 of the following Table of Deposition Techniques ;

    - a. to non-electronic substrates, specified in column 2 of the following Table;
    - b. by processes specified in column 1 of the following Table and defined in the Technical Note;

**Table - Deposition Techniques**

Coating Process (1)*	Substrate	Resultant Coating	
A. Chemical Vapour Deposition (CVD)	"Superalloys"	Aluminides for internal passages	
	Ceramics and Low-expansion glasses (14)	Silicides Carbides Dielectric layers (15)	
	Carbon-carbon, Ceramic and Metal "matrix"composites"	Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15) Aluminides Alloyed aluminides (2)	
	Cemented tungsten carbide (16), Silicon carbide	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15)	
	Molybdenum and Molybdenum alloys Beryllium and Beryllium alloys Sensor window materials (9)	Dielectric layers (15) Dielectric layers (15) Dielectric layers (15)	
B. Thermal-Evaporation Physical Vapour Deposition (TE-PVD)	1. Physical Vapour Deposition (PVD): Electron-Beam (EB-PVD)	"Superalloys"	Alloyed silicides Alloyed aluminides (2) MCrAlX (5) Modified zirconia (12) Silicides Aluminides Mixtures thereof (4)
		Ceramics and Low-expansion glasses (14)	Dielectric layers (15)
		Corrosion resistant steel (7)	MCrAlX (5) Modified zirconia (12) Mixtures thereof (4)
		Carbon-carbon, Ceramic and Metal "matrix"composites"	Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15)
		Cemented tungsten carbide (16), Silicon carbide	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15)
		Molybdenum and Molybdenum alloys Beryllium and Beryllium alloys Sensor window materials (9) Titanium alloys (13)	Dielectric layers (15) Dielectric layers (15) Borides Dielectric layers (15) Borides Nitrides
		2. Ion assisted resistive heating Physical Vapour Deposition (Ion Plating)	Ceramics and Low-expansion glasses (14)
	Carbon-carbon, Ceramic and Metal "matrix"composites"		Dielectric layers (15)
	Cemented tungsten carbide (16), Silicon carbide		Dielectric layers (15)
	Molybdenum and Molybdenum alloys		Dielectric layers (15)
	Beryllium and Beryllium alloys		Dielectric layers (15)
	Sensor window materials (9)		Dielectric layers (15)

\* The numbers in parenthesis refer to the Notes following this Table

Coating Process (1)*		Substrate	Resultant Coating
B.	3. Physical Vapour Deposition: "laser" evaporation	Ceramics and Low-expansion glasses (14)	Silicides Dielectric layers (15)
		Carbon-carbon, Ceramic and Metal "matrix"composites"	Dielectric layers (15)
		Cemented tungsten carbide (16), Silicon carbide	Dielectric layers (15)
		Molybdenum and Molybdenum alloys	Dielectric layers (15)
		Beryllium and Beryllium alloys	Dielectric layers (15)
	4. Physical Vapour Deposition: cathodic arc discharge	Sensor window materials (9)	Dielectric layers (15) Diamond-like carbon
	"Superalloys"	Alloyed silicides Alloyed aluminides (2) MCrAIX (5)	
	Polymers (11) and Organic "matrix composites"	Borides Carbides Nitrides	
C.	Pack cementation (see A above for out-of-pack cementation) (10)	Carbon-carbon, Ceramic and Ceramic and metal "matrix"composites"	Silicides Carbides Mixtures thereof (4)
		Titanium alloys (13)	Silicides Aluminides Alloyed aluminides (2)
		Refractory metals and alloys (8)	Silicides Oxides
D.	Plasma spraying	"Superalloys"	MCrAIX (5) Modified zirconia (12) Mixtures thereof (4) Abradable Nickel- Graphite Abradable Ni-Cr-Al-Bentonite Abradable Al-Si- Polyester Alloyed aluminides (2)
		Aluminium alloys (6)	MCrAIX (5) Modified zirconia (12) Silicides Mixtures thereof (4)
		Refractory metals and alloys (8)	Aluminides Silicides Carbides
		Corrosion resistant steel (7)	Modified zirconia (12) Mixtures thereof (4)
		Titanium alloys (13)	Carbides Aluminides Silicides Alloyed aluminides (2) Abradable Nickel- Graphite Abradable Ni-Cr-Al-Bentonite Abradable Al-Si-Polyester

\* The numbers in parenthesis refer to the Notes following this Table

Coating Process (1)*	Substrate	Resultant Coating
E. Slurry Deposition and alloys (8)	Refractory metals	Fused silicides Fused aluminides except for resistance heating elements
	Carbon-carbon, Ceramic and Metal "matrix" composites"	Silicides Carbides Mixtures thereof (4)
F. Sputter Deposition	"Superalloys"	Alloyed silicides Alloyed aluminides (2) Noble metal modified aluminides (3) MCrAlX (5) Modified zirconia (12) Platinum Mixtures thereof (4)
	Ceramics and Low-expansion glasses (14)	Silicides Platinum Mixtures thereof (4) Dielectric layers (15)
	Titanium alloys (13)	Borides Nitrides Oxides Silicides Aluminides Alloyed aluminides (2) Carbides
	Carbon-carbon, Ceramic and Metal "matrix" composites"	Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15)
	Cemented tungsten carbide (16), Silicon carbide	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15)
	Molybdenum and Molybdenum alloys Beryllium and Beryllium alloys Sensor window materials (9)	Dielectric layers (15) Borides Dielectric layers (15) Dielectric layers (15)
	Refractory metals and alloys (8)	Aluminides Silicides Oxides Carbides
G. Ion Implantation	High temperature bearing steels	Additions of Chromium, Tantalum or Niobium (Columbium)
	Titanium alloys (13)	Borides Nitrides
	Beryllium and Beryllium alloys	Borides
	Cemented tungsten carbide (16)	Carbides Nitrides

\* The numbers in parenthesis refer to the Notes following this Table

### Notes applicable to Table – Deposition Techniques:

1. The term 'coating process' includes coating repair and refurbishing as well as original coating.
2. The term 'alloyed aluminide coating' includes single or multiple-step coatings in which an element or elements are deposited prior to or during application of the aluminide coating, even if these elements are deposited by another coating process. It does not, however, include the multiple use of single-step pack cementation processes to achieve alloyed aluminides.
3. The term 'noble metal modified aluminide' coating includes multiple-step coatings in which the noble metal or noble metals are laid down by some other coating process prior to application of the aluminide coating.
4. 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 the Table.
5. MCrAlX refers to a coating alloy where M equals cobalt, iron, nickel or combinations thereof and X equals hafnium, yttrium, silicon, tantalum in any amount or other intentional additions over 0.01 weight percent in various proportions and combinations, except:
  - a. CoCrAlY coatings which contain less than 22 weight percent of chromium, less than 7 weight percent of aluminium and less than 2 weight percent of yttrium;
  - b. CoCrAlY coatings which contain 22 to 24 weight percent of chromium, 10 to 12 weight percent of aluminium and 0.5 to 0.7 weight percent of yttrium; **or**
  - c. NiCrAlY coatings which contain 21 to 23 weight percent of chromium, 10 to 12 weight percent of aluminium and 0.9 to 1.1 weight percent of yttrium.
6. The term 'aluminium alloys' refers to alloys having an ultimate tensile strength of 190 MPa or more measured at 293 K (20°C).
7. The term 'corrosion resistant steel' refers to AISI (American Iron and Steel Institute) 300 series or equivalent national standard steels.
8. Refractory metals consist of the following metals and their alloys: niobium (columbium), molybdenum, tungsten and tantalum.
9. Sensor window materials, as follows: alumina, silicon, germanium, zinc sulphide, zinc selenide, gallium arsenide and the following metal halides: potassium iodide, potassium fluoride, or sensor window materials of more than 40 mm diameter for thallium bromide and thallium chlorobromide.
10. Technology for single-step pack cementation of solid airfoils is not embargoed by Category 1020.
11. Polymers, as follows: polyimide, polyester, polysulphide, polycarbonates and polyurethanes.
12. Modified zirconia refers to additions of other metal oxides, e.g. calcia, magnesia, yttria, hafnia, rare earth oxides, etc., to zirconia in order to stabilise certain crystallographic phases and phase compositions. Thermal barrier coatings made of zirconia, modified with calcia or magnesia by mixing or fusion, are not embargoed.
13. Titanium alloys refers to aerospace alloys having an ultimate tensile strength of 900 MPa or more measured at 293 K (20°C).
14. Low-expansion glasses refers to glasses which have a coefficient of thermal expansion of  $1 \times 10^{-7} \text{ K}^{-1}$  or less measured at 293 K (20°C).
15. Dielectric layers are coatings constructed of multi-layers of insulator materials in which the interference properties of a design composed of materials of various refractive indices are used to reflect, transmit or absorb various wavelength bands. Dielectric layers refers to more than four dielectric layers or dielectric/metal "composite" layers.
16. Cemented tungsten carbide does not include cutting and forming tool materials consisting of tungsten carbide/(cobalt, nickel), titanium carbide/(cobalt, nickel), chromium carbide/nickel-chromium and chromium carbide/nickel

### Technical Notes to Table – Deposition Techniques:

Processes specified in Column 1 of the Table are defined as follows:

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

### N.B.:

1. CVD includes the following processes: directed gas flow out-of-pack deposition, pulsating CVD, controlled nucleation thermal decomposition (CNTD), plasma enhanced or plasma assisted CVD processes.
  2. Pack denotes a substrate immersed in a powder mixture.
  3. The gaseous reactants used in the out-of-pack process are produced using the same basic reactions and parameters as the pack cementation process, except that the substrate to be coated is not in contact with the powder mixture.
- b. Thermal Evaporation-Physical Vapour Deposition (TE-PVD) is an overlay coating process conducted in a vacuum with a pressure less than 0.1 Pa wherein a source of thermal energy is used to vaporize the coating material. This process results in the condensation, or deposition, of the evaporated species onto appropriately positioned substrates. The addition of gases to the vacuum chamber during the coating process to synthesize compound coatings is an ordinary modification of the process. The use of ion or electron beams, or plasma, to activate or assist the coating's deposition is also a common modification in this technique. The use of monitors to provide in-process measurement of optical characteristics and thickness of coatings can be a feature of these processes. Specific TE-PVD processes are as follows:
1. Electron Beam PVD uses an electron beam to heat and evaporate the material which forms the coating;
  2. Resistive Heating PVD employs electrically resistive heating sources capable of producing a controlled and uniform flux of evaporated coating species;
  3. "Laser" Evaporation uses either pulsed or continuous wave "laser" beams to heat the material which forms the coating;
  4. Cathodic Arc Deposition employs a consumable cathode of the material which forms the coating and has an arc discharge established on the surface by a momentary contact of a ground trigger. Controlled motion of arcing erodes the cathode surface creating a highly ionized plasma. The anode can be either a cone attached to the periphery of the cathode, through an insulator, or the chamber. Substrate biasing is used for non line-of-sight deposition.

### N.B.:

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

- c. Ion Plating is a special modification of a general TE-PVD process in which a plasma or an ion source is used to ionize the species to be deposited, and a negative bias is applied to the substrate in order to facilitate the extraction of the species to be deposited from the plasma. The introduction of reactive species, evaporation of solids within the process chamber, and the use of monitors to provide in-process measurement of optical characteristics and thicknesses of coatings are ordinary modifications of the process.
- d. Pack Cementation is a surface modification coating or overlay coating process wherein a substrate is immersed in a powder mixture (a pack), that consists of:
  1. The metallic powders that are to be deposited (usually 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 (757°C) and 1,375 K (1,102°C) 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 powder or wire coating materials, melts them and propels them towards a substrate, whereon an integrally bonded coating is formed. Plasma spraying constitutes either low pressure plasma spraying or high velocity plasma spraying carried out underwater.

### N.B.:

1. Low pressure means less than ambient atmospheric pressure.
  2. High velocity refers to nozzle-exit gas velocity exceeding 750 m/s calculated at 293 K (20°C) at 0.1 MPa.
- 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, subsequent air or oven drying, and heat treatment to obtain the desired coating.

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

**N.B.**

1. The Table refers only to triode, magnetron or reactive sputter deposition which is used to increase adhesion of the coating and rate of deposition and to radio frequency (RF) augmented sputter deposition used to permit vapourisation of non-metallic coating materials.
  2. Low-energy ion beams (less than 5 keV) can be used to activate the deposition.
- h. *Ion Implantation* is a surface modification coating process in which the element to be alloyed is ionized, accelerated through a potential gradient and implanted into the surface region of the substrate. This includes processes in which ion implantation is performed simultaneously with electron beam physical vapour deposition or sputter deposition.

**Statement of Understanding**

It is understood that the following technical information, accompanying the table of deposition techniques, is for use as appropriate.

1. Technology for pretreatments of the substrates listed in the Table, as follows:
  - a. Chemical stripping and cleaning bath cycle parameters, as follows:
    1. Bath composition
      - a. For the removal of old or defective coatings, corrosion product or foreign deposits;
      - b. For preparation of virgin substrates;
    2. Time in bath;
    3. Temperature of bath;
    4. Number and sequences of wash cycles;
  - b. Visual and macroscopic criteria for acceptance of the cleaned part;
  - c. Heat treatment cycle parameters, as follows:
    1. Atmosphere parameters, as follows:
      - a. Composition of the atmosphere;
      - b. Pressure of the atmosphere;
    2. Temperature for heat treatment;
    3. Time of heat treatment;
  - d. Substrate surface preparation parameters, as follows:
    1. Grit blasting parameters, as follows:
      - a. Grit composition;
      - b. Grit size and shape;
      - c. Grit velocity;
    2. Time and sequence of cleaning cycle after grit blast;
    3. Surface finish parameters;
  - e. Masking technique parameters, as follows:
    1. Material of mask;
    2. Location of mask;
2. Technology for in situ quality assurance techniques for evaluation of the coating processes listed in the Table, as follows:
  - a. Atmosphere parameters, as follows:
    1. Composition of the atmosphere;
    2. Pressure of the atmosphere;
  - b. Time parameters;
  - c. Temperature parameters;
  - d. Thickness parameters;
  - e. Index of refraction parameters;
3. Technology for post deposition treatments of the coated substrates listed in the Table, as follows:
  - a. Shot peening parameters, as follows:
    1. Shot composition;
    2. Shot size;
    3. Shot velocity;
  - b. Post shot peening cleaning parameters;
  - c. Heat treatment cycle parameters, as follows:
    1. Atmosphere parameters, as follows:
      - a. Composition of the atmosphere;
      - b. Pressure of the atmosphere;
    2. Time-temperature cycles;
  - d. Post heat treatment visual and macroscopic criteria for acceptance of the coated substrates;
4. 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:
    1. Magnification;
    2. Coating thickness uniformity;
    3. Coating integrity;
    4. Coating composition;
    5. Coating and substrates bonding;
    6. Microstructural uniformity.
  - c. Criteria for optical properties assessment:
    1. Reflectance;
    2. Transmission;
    3. Absorption;
    4. Scatter;
5. Technology and parameters related to specific coating and surface modification processes listed in the Table, as follows:
  - a. For Chemical Vapour Deposition:
    1. Coating source composition and formulation;
    2. Carrier gas composition;
    3. Substrate temperature;
    4. Time-temperature-pressure cycles;
    5. Gas control and part manipulation;
  - b. For Thermal Evaporation - Physical Vapour Deposition:
    1. Ingot or coating material source composition;
    2. Substrate temperature;
    3. Reactive gas composition;
    4. Ingot feed rate or material vaporisation rate;
    5. Time-temperature-pressure cycles;
    6. Beam and part manipulation;
    7. "Laser" parameters, as follows:
      - a. Wave length;
      - b. Power density;
      - c. Pulse length;
      - d. Repetition ratio;
      - e. Source;
      - f. Substrate orientation;
  - c. For Pack Cementation:
    1. Pack composition and formulation;
    2. Carrier gas composition;
    3. Time-temperature-pressure cycles;
  - d. For Plasma Spraying:
    1. Powder composition, preparation and size distributions;
    2. Feed gas composition and parameters;
    3. Substrate temperature;
    4. Gun power parameters;
    5. Spray distance;
    6. Spray angle;
    7. Cover gas composition, pressure and flow rates;
    8. Gun control and part manipulation;
  - e. For Sputter Deposition:
    1. Target composition and fabrication;
    2. Geometrical positioning of part and target;
    3. Reactive gas composition;
    4. Electrical bias;
    5. Time-temperature-pressure cycles;
    6. Triode power;
    7. Part manipulation;
  - f. For ion Implantation:
    1. Beam control and part manipulation;
    2. Ion source design details;
    3. Control techniques for ion beam and deposition rate parameters;
    4. Time-temperature-pressure cycles.
  - g. For Ion Plating:
    1. Beam control and part manipulation;
    2. Ion source design details;
    3. Control techniques for ion beam and deposition rate parameters;
    4. Time-temperature-pressure cycles;
    5. Coating material feed rate and vaporisation rate;
    6. Substrate temperature;
    7. Substrate bias parameters.

## 1030. Electronics

### 1031. Equipment, Assemblies and Components

#### Notes

1. The embargo status of equipment, devices and components described in 1031., other than those described in 1031.1.a.3. to 10. or 1031.1.a.12., which are specially designed for or which have the same functional characteristics as other equipment is determined by the embargo status of the other equipment.
2. The embargo status of integrated circuits described in 1031.1.a.3. to 9. or 1031.1.a.12. which are unalterably programmed or designed for a specific function for another equipment is determined by the embargo status of the other equipment.

#### N.B.:

When the manufacturer or applicant cannot determine the embargo status of the other equipment, the embargo status of the integrated circuits is determined in 1031.1.a.3. to 9. or 1031.1.a.12.

If the integrated circuit is a silicon-based "microcomputer microcircuit" or microcontroller microcircuit described in 1031.1.a.3. having an operand (data) word length of 8 bit or less, the embargo status of the integrated circuit is determined in 1031.1.a.3.

1. Electronic devices and components:
  - a. General purpose integrated circuits, as follows:

#### Notes

1. The embargo status of wafers (finished or unfinished), in which the function has been determined, is to be evaluated against the parameters of 1031.1.a.
2. Integrated circuits include the following types:
  - "Monolithic integrated circuits";
  - "Hybrid integrated circuits";
  - "Multichip integrated circuits";
  - "Film type integrated circuits", including silicon-on-sapphire integrated circuits;
  - "Optical integrated circuits".

- 1 a. 1. Integrated circuits, designed or rated as radiation hardened to withstand either of the following:
  - a. A total dose of  $5 \times 10^5$  Rads (Si) or higher; **or**
  - b. A dose rate upset of  $5 \times 10^8$  Rads (Si)/s or higher;
2. Integrated circuits described in 1031.1.a.3 to 10. or 1031.1.a.12., as follows:
  - a. Rated for operation at an ambient temperature above 398 K (+125°C);
  - b. Rated for operation at an ambient temperature below 218 K (-55°C); **or**
  - c. Rated for operation over the entire ambient temperature range from 218 K (-55°C) to 398 K (+125°C);

#### Note

1031.1.a.2. does not apply to integrated circuits for civil automobile or railway train applications.

3. "Microprocessor microcircuits", "microcomputer microcircuits" and microcontroller microcircuits, having any of the following:

#### Note

1031.1.a.3. includes digital signal processors, digital array processors and digital coprocessors.

- a. An arithmetic logic unit with an access width of 32 bit or more and a "composite theoretical performance" ("CTP") of 80 million theoretical operations per second (Mtops) or more;
  - b. Manufactured from a compound semiconductor and operating at a clock frequency exceeding 40 MHz; **or**
  - c. More than one data or instruction bus or serial communication port for external interconnection in a parallel processor with a transfer rate exceeding 2.5 Mbyte/s;
4. Electrically erasable programmable read-only memories (EEPROMs), static random-access memories (SRAMs); **and** storage integrated circuits manufactured from a compound semiconductor, as follows:
    - a. EEPROMs with a storage capacity:

1. Exceeding 16 Mbit per package for flash memory types; **or**
  2. Exceeding either of the following limits for all other EEPROM types:
    - a. 4 Mbit per package; **or**
    - b. 1 Mbit per package and having a maximum access time of less than 80 ns;
  - b. SRAMs with a storage capacity:
    1. Exceeding 4 Mbit per package; **or**
    2. Exceeding 1 Mbit per package and having a maximum access time of less than 20 ns;
  - c. Storage integrated circuits manufactured from a compound semiconductor;
5. Analogue-to-digital and digital-to-analogue converter integrated circuits, as follows:
    - a. Analogue-to-digital converters having any of the following:
      1. A resolution of 8 bit or more, but less than 12 bit, with a total conversion time to maximum resolution of less than 10 ns;
      2. A resolution of 12 bit with a total conversion time to maximum resolution of less than 200 ns; **or**
      3. A resolution of more than 12 bit with a total conversion time to maximum resolution of less than 2  $\mu$ s;
    - b. Digital-to-analogue converters with a resolution of 12 bit or more, and a "settling time" of less than 10 ns;
  6. Electro-optical and "optical integrated circuits" for "signal processing" having all of the following:
    - a. One or more internal "laser" diodes;
    - b. One or more internal light detecting elements; **and**
    - c. Optical waveguides;
  7. Field programmable gate arrays having either of the following:
    - a. An equivalent usable gate count of more than 30,000 (2 input gates); **or**
    - b. A typical "basic gate propagation delay time" of less than 0.4 ns;
  8. Field programmable logic arrays having either of the following:
    - a. An equivalent usable gate count of more than 30,000 (2 input gates); **or**
    - b. A toggle frequency exceeding 133 MHz;
  9. Neural network integrated circuits;
  10. Custom integrated circuits for which either the function is unknown, or the embargo status of the equipment in which the integrated circuits will be used is unknown to the manufacturer, having any of the following:
    - a. More than 144 terminals;
    - b. A typical "basic gate propagation delay time" of less than 0.4 ns; **or**
    - c. An operating frequency exceeding 3 GHz;
  11. Digital integrated circuits, other than those described in 1031.1.a.3 to 10. or 1031.1.a.12., based upon any compound semiconductor and having either of the following:
    - a. An equivalent gate count of more than 300 (2 input gates); **or**
    - b. A toggle frequency exceeding 1.2 GHz;
  12. Fast Fourier Transform (FFT) processors having any of the following:
    - a. A rated execution time for a 1,024-point complex FFT of less than 1 ms;
    - b. A rated execution time for an N-point complex FFT of other than  $1,024 \log_2 N / 10,240$  ms, where N is the number of points; **or**
    - c. A butterfly throughput of more than 5.12 MHz;
- b. Microwave or millimetre wave devices:
    1. Electronic vacuum tubes and cathodes, as follows:

(For frequency agile magnetron tubes, see Item 2011 on the Munitions List.)

#### Note

1031.1.b.1. does not embargo tubes designed or rated to operate in the Standard Civil Telecommunications Bands at frequencies not exceeding 31 GHz.

**1031. cont'd.**

1. b. 1. a. Travelling wave tubes, pulsed or continuous wave, as follows:
  1. Operating at frequencies higher than 31 GHz;
  2. Having a cathode heater element with a turn on time to rated RF power of less than 3 seconds;
  3. Coupled cavity tubes, or derivatives thereof, with an "instantaneous bandwidth" of more than 7% or a peak power exceeding 2.5 kW;
  4. Helix tubes, or derivatives thereof, with any of the following characteristics:
    - a. An "instantaneous bandwidth" of more than one octave, and average power (expressed in kW) times frequency (expressed in GHz) of more than 0.5;
    - b. An "instantaneous bandwidth" of one octave or less, and average power (expressed in kW) times frequency (expressed in GHz) of more than 1; **or**
    - c. "Space qualified";
  - b. Crossed-field amplifier tubes with a gain of more than 17 dB;
  - c. Impregnated cathodes for electronic tubes, with either of the following:
    1. A turn on time to rated emission of less than 3 seconds; **or**
    2. Producing a continuous emission current density at rated operating conditions exceeding 5 A/cm<sup>2</sup>;
2. Microwave integrated circuits or modules containing "monolithic integrated circuits" operating at frequencies exceeding 3 GHz;
 

**Note**  
1031.1.b.2. does not embargo circuits or modules for equipment designed or rated to operate in the Standard Civil Telecommunications Bands at frequencies not exceeding 31 GHz.
3. Microwave transistors rated for operation at frequencies exceeding 31 GHz;
4. Microwave solid state amplifiers, as follows:
  - a. Operating at frequencies exceeding 10.5 GHz and having an "instantaneous bandwidth" of more than half an octave;
  - b. Operating at frequencies exceeding 31 GHz;
5. Electronically or magnetically tunable band-pass or band-stop filters having more than 5 tunable resonators capable of tuning across a 1.5:1 frequency band ( $f_{max}/f_{min}$ ) in less than 10 μs with either:
  - a. A band-pass bandwidth of more than 0.5% of centre frequency; **or**
  - b. A band-stop bandwidth of less than 0.5% of centre frequency;
6. Microwave assemblies capable of operating at frequencies exceeding 31 GHz;
7. Mixers and converters designed to extend the frequency range of equipment described in 1031.2.c., 1031.2.e. or 1031.2.f. beyond the limits stated therein;
- c. Acoustic wave devices, as follows, and specially designed components therefor:
  1. Surface acoustic wave and surface skimming (shallow bulk) acoustic wave devices (i.e. "signal processing" devices employing elastic waves in materials), having any of the following:
    - a. A carrier frequency exceeding 2.5 GHz;
    - b. A carrier frequency of 2.5 GHz or less, and:
      1. A frequency side-lobe rejection exceeding 55 dB;
      2. A product of the maximum delay time and the bandwidth (time in μs and bandwidth in MHz) of more than 100; **or**
      3. A dispersive delay of more than 10 μs; **or**
    - c. A carrier frequency exceeding 1 GHz and a bandwidth of 250 MHz or more;
  2. Bulk (volume) acoustic wave devices (i.e. "signal processing" devices employing elastic waves) which permit the direct processing of signals at frequencies exceeding 1 GHz;
  3. Acoustic-optic "signal processing" devices employing interaction between acoustic waves (bulk wave or surface wave) and light waves which permit the direct processing of signals or images, including spectral analysis, correlation or convolution;
- d. Electronic devices or circuits containing components, manufactured from "superconductive" materials specially designed for operation at temperatures below the "critical temperature" of at least one of the "superconductive" constituents, with any of the following:
  1. Electromagnetic amplification:
    - a. At frequencies equal to or less than 31 GHz with a noise figure of less than 0.5 dB; **or**
    - b. At frequencies exceeding 31 GHz;
  2. Current switching for digital circuits using "superconductive" gates with a product of delay time per gate (in seconds) and power dissipation per gate (in watts) of less than 10<sup>-14</sup> J; **or**
  3. Frequency selection at all frequencies using resonant circuits with Q-values exceeding 10,000;
- e. High energy devices, as follows:
  1. Batteries, as follows:
 

**Note**  
1031.1.e.1. does not embargo batteries with volumes equal to or less than 27 cm<sup>3</sup> (e.g. standard C-cells or R14 batteries).

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

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

    - c. "Space qualified" and radiation hardened photovoltaic arrays with a specific power exceeding 160 W/m<sup>2</sup> at an operating temperature of 301 K (28°C) under a tungsten illumination of 1 kW/m<sup>2</sup> at 2,800 K (2,527°C);
  2. High energy storage capacitors, as follows:
    - a. Capacitors with a repetition rate of less than 10 Hz (single shot capacitors) having all of the following:
      1. A voltage rating equal to or more than 5 kV;
      2. An energy density equal to or more than 250 J/kg; **and**
      3. A total energy equal to or more than 25 kJ;
    - b. Capacitors with a repetition rate of 10 Hz or more (repetition rated capacitors) having all of the following:
      1. A voltage rating equal to or more than 5 kV;
      2. An energy density equal to or more than 50 J/kg;
      3. A total energy equal to or more than 100 J; **and**
      4. A charge/discharge cycle life equal to or more than 10,000;
  3. "Superconductive" electromagnets or solenoids specially designed to be fully charged or discharged in less than one second, having all of the following:
 

**Note**  
1031.1.e.3. does not embargo "superconductive" electromagnets or solenoids specially designed for Magnetic Resonance Imaging (MRI) medical equipment.

    - a. Energy delivered during the discharge exceeding 10 kJ in the first second;
    - b. Inner diameter of the current carrying windings of more than 250 mm; **and**
    - c. Rated for a magnetic induction of more than 8 T or "overall current density" in the winding of more than 300 A/mm<sup>2</sup>;
  4. Circuits or systems for electromagnetic energy storage, containing components manufactured from "superconductive" materials specially designed for operation at temperatures below the "critical temperature" of at least one of their "superconductive" constituents, having all of the following:
    - a. Resonant operating frequencies exceeding 1 MHz;
    - b. A stored energy density of 1 MJ/m<sup>3</sup> or more; **and**
    - c. A discharge time of less than 1 ms;
  5. Flash discharge type X-ray systems, and tubes therefor, having all of the following:
    - a. A peak power exceeding 500 MW;
    - b. An output voltage exceeding 500 kV; **and**
    - c. A pulse width of less than 0.2 μs;

### 1031. cont'd.

1. f. Rotary input type shaft absolute position encoders having either of the following:
  1. A resolution of better than 1 part in 265,000 (18 bit resolution) of full scale; **or**
  2. An accuracy better than  $\pm 2.5$  seconds of arc;
2. General purpose electronic equipment:
  - a. Recording equipment, as follows, and specially designed test tape therefor:
    1. Analogue instrumentation magnetic tape recorders, including those permitting the recording of digital signals (e.g. using a high density digital recording (HDDR) module), having any of the following:
      - a. A bandwidth exceeding 4 MHz per electronic channel or track;
      - b. A bandwidth exceeding 2 MHz per electronic channel or track and having more than 42 tracks; **or**
      - c. A time displacement (base) error, measured in accordance with applicable IRIG or EIA documents, of less than  $\pm 0.1 \mu\text{s}$ ;
    2. Digital video magnetic tape recorders having a maximum digital interface transfer rate exceeding 180 Mbit/s, except those specially designed for television recording using a signal format standardized or recommended by the CCIR or the IEC for civil television applications;
    3. Digital instrumentation magnetic tape data recorders employing helical scan techniques or fixed head techniques, having either of the following:
      - a. A maximum digital interface transfer rate exceeding 175 Mbit/s; **or**
      - b. "Space qualified";

#### Note

1031.2.a.3 does not embargo analogue magnetic tape recorders equipped with HDDR conversion electronics and configured to record only digital data.

4. Equipment, with a maximum digital interface transfer rate exceeding 175 Mbit/s, designed to convert digital video magnetic tape recorders for use as digital instrumentation data recorders;
5. Waveform digitisers and transient recorders with both of the following:
  - a. Digitising rates equal to or more than 200 million samples per second and a resolution of 10 bits or more; **and**
  - b. A continuous throughput of 2 Gbits/s or more;

#### Technical Note

For those instruments with a parallel bus architecture, the continuous throughput rate is the highest word rate multiplied by the number of bits in a word.

Continuous throughput is the fastest data rate the instrument can output to mass storage without the loss of any information whilst sustaining the sampling rate and analogue-to-digital conversion.

- b. "Frequency synthesiser" "assemblies" having a "frequency switching time" from one selected frequency to another of less than 1 ms;
- c. "Signal analysers", as follows:
  1. Capable of analysing frequencies exceeding 31 GHz;
  2. "Dynamic signal analysers" with a "real-time bandwidth" exceeding 25.6 kHz, except those using only constant percentage bandwidth filters (also known as octave or fractional octave filters);
- d. Frequency synthesised signal generators producing output frequencies, the accuracy and short term and long term stability of which are controlled, derived from or disciplined by the internal master frequency, and having any of the following:
  1. A maximum synthesised frequency exceeding 31 GHz;
  2. A "frequency switching time" from one selected frequency to another of less than 1 ms; **or**
  3. A single sideband (SSB) phase noise better than  $-(126 + 20 \log_{10} F - 20 \log_{10} f)$  in dBc/Hz, where F is the off-set from the operating frequency in Hz and f is the operating frequency in MHz;

#### Note:

1031.2.d. does not embargo equipment in which the output frequency is either produced by the addition or subtraction of two or more crystal oscillator frequencies, or by an addition or subtraction followed by a multiplication of the result.

- e. Network analysers with a maximum operating frequency exceeding 31 GHz;

#### Note

1031.2.e. does not embargo "swept frequency network analysers" with a maximum operating frequency not exceeding 40 GHz and which do not contain a data bus for remote control interfacing.

- f. Microwave test receivers with both of the following:
  1. A maximum operating frequency exceeding 31 GHz; **and**
  2. Capable of measuring amplitude and phase simultaneously;
- g. Atomic frequency standards having either of the following:
  1. Long term stability (aging) less (better) than  $1 \times 10^{-11}$  /month; **or**
  2. "Space qualified";

#### Note

1031.2.g.1. does not embargo non-"space qualified" rubidium standards.

- h. Emulators for microcircuits embargoed by 1031.1.a.3. or 1031.1.a.9.

#### Note

1031.2.h. does not embargo emulators designed for a "family" which contains at least one device not embargoed by 1031.1.a.3. or 1031.1.a.9.

## 1032. Test, Inspection and Production Equipment

Equipment for the manufacture or testing of semiconductor devices or materials, as follows, and specially designed components and accessories therefor:

1. "Stored programme controlled" equipment for epitaxial growth, as follows:
  - a. Capable of producing a layer thickness uniform to less than  $\pm 2.5\%$  across a distance of 75 mm or more;
  - b. Metal organic chemical vapour deposition (MOCVD) reactors specially designed for compound semiconductor crystal growth by the chemical reaction between materials embargoed by 1033.3 or 1033.4;
  - c. Molecular beam epitaxial growth equipment using gas sources;
2. "Stored programme controlled" equipment designed for ion implantation, having any of the following:
  - a. An accelerating voltage exceeding 200 keV;
  - b. Specially designed and optimized to operate at an accelerating voltage of less than 10 keV;
  - c. Direct write capability; **or**
  - d. Capable of high energy oxygen implant into a heated semiconductor material "substrate";
3. "Stored programme controlled" anisotropic plasma dry etching equipment, as follows:
  - a. With cassette-to-cassette operation and load-locks, and having either of the following:
    1. Magnetic confinement; **or**
    2. Electron cyclotron resonance (ECR);
  - b. Specially designed for equipment embargoed by 1032.5. and having either of the following:
    1. Magnetic confinement; **or**
    2. ECR;
4. "Stored programme controlled" plasma enhanced CVD equipment, as follows:
  - a. With cassette-to-cassette operation and load-locks, and having either of the following:
    1. Magnetic confinement; **or**
    2. ECR;
  - b. Specially designed for equipment embargoed by 1032.5. and having either of the following:
    1. Magnetic confinement; **or**
    2. ECR;
5. "Stored programme controlled" automatic loading multi-chamber central wafer handling systems, having interfaces for wafer input and output, to which more than two pieces of semiconductor processing equipment are to be connected, to form an integrated system in a vacuum environment for sequential multiple wafer processing;

#### Note

1032.5. does not embargo automatic robotic wafer handling systems not designed to operate in a vacuum environment.

6. "Stored programme controlled" lithography equipment, as follows:
  - a. Align and expose step and repeat equipment for wafer processing using photo-optical or X-ray methods, having either of the following:
    1. A light source wavelength shorter than 400 nm; **or**

### 1032. cont'd.

6. a. 2. Capable of producing a pattern with a minimum resolvable feature size of 0.7  $\mu\text{m}$  or less when calculated by the following formula:

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

where the K factor = 0.7.

MRF = minimum resolvable feature size.

6. b. Equipment specially designed for mask making or semiconductor device processing using deflected focussed electron beam, ion beam or "laser" beam, with any of the following:
1. A spot size smaller than 0.2  $\mu\text{m}$ ;
  2. Capable of producing a pattern with a feature size of less than 1  $\mu\text{m}$ ; or
  3. An overlay accuracy of better than  $\pm 0.20 \mu\text{m}$  (3 sigma);
7. Masks or reticles, as follows:
- a. For integrated circuits embargoed by 1031.1.;
  - b. Multi-layer masks with a phase shift layer;
8. "Stored programme controlled" test equipment, specially designed for testing semiconductor devices and unencapsulated dice, as follows:
- a. For testing S-parameters of transistor devices at frequencies exceeding 31 GHz;
  - b. For testing integrated circuits capable of performing functional (truth table) testing at a pattern rate of more than 40 MHz;

#### Notes

1032.8.b. does not embargo test equipment specially designed for testing:

1. "Assemblies" or a class of "assemblies" for home or entertainment applications;
2. Unembargoed electronic components, "assemblies" or integrated circuits.

- c. For testing microwave integrated circuits at frequencies exceeding 3 GHz;

#### Note

1032.8.c. does not embargo test equipment specially designed for testing microwave integrated circuits for equipment designed or rated to operate in the Standard Civil Telecommunication Bands at frequencies not exceeding 31 GHz.

- d. Electron beam systems designed for operation at 3 keV or below, or "laser" beam systems, for the non-contactive probing of powered-up semiconductor devices, with both of the following:
  1. Stroboscopic capability with either beam-blanking or detector strobing; and
  2. An electron spectrometer for voltage measurement with a resolution of less than 0.5 V.

#### Note

1032.8.d. does not embargo scanning electron microscopes, except when specially designed and instrumented for the non-contactive probing of powered-up semiconductor devices.

### 1033. Materials

1. Hetero-epitaxial materials consisting of a "substrate" with stacked epitaxially grown multiple layers of:
  - a. Silicon;
  - b. Germanium; or
  - c. III/V compounds of gallium or indium;

#### Technical Note

III/V compounds are polycrystalline or binary or complex monocrystalline products consisting of elements of groups IIIA and VA of Mendeleev's periodic classification table (gallium arsenide, gallium-aluminium arsenide, indium phosphide, etc.).

2. Resist materials, as follows, and "substrates" coated with embargoed resists:
  - a. Positive resists for semiconductor lithography specially adjusted (optimised) for use at wavelengths below 370 nm ;
  - b. All resists, for use with electron beams or ion beams, with a sensitivity of 0.01  $\mu\text{Coulomb}/\text{mm}^2$  or better;
  - c. All resists, for use with X-rays, with a sensitivity of 2.5  $\text{mJ}/\text{mm}^2$  or better;
  - d. All resists optimized for surface imaging technologies, including silylated resists;

#### Technical Note

Silylation techniques are defined as processes incorporating oxidation of the resist surface to enhance performance for both wet and dry developing.

3. Organo-inorganic compounds as follows:
  - a. Organo-metallic compounds of aluminium, gallium or indium having a purity (metal basis) better than 99.999%;
  - b. Organo-arsenic, organo-antimony and organo-phosphorus compounds having a purity (inorganic element basis) better than 99.999%.

#### Note

1033.3. only embargoes compounds whose metallic, partly metallic or non-metallic element is directly linked to carbon in the organic part of the molecule.

4. Hydrides of phosphorus, arsenic or antimony, having a purity better than 99.999%, even diluted in inert gases or hydrogen.

#### Note

1033.4. does not embargo hydrides containing 20% molar or more of inert gases or hydrogen.

### 1034. Software

1. "Software" specially designed for the "development" or "production" of equipment embargoed by 1031.1.b. to 1031.2.h. or 1032.;
2. "Software" specially designed for the "use" of "stored programme controlled" equipment embargoed by 1032.;
3. Computer-aided-design (CAD) "software" for semiconductor devices or integrated circuits, having any of the following:
  - a. Design rules or circuit verification rules;
  - b. Simulation of the physically laid out circuits; or
  - c. Lithographic processing simulators for design.

#### Technical Note

A lithographic processing simulator is a "software" package used in the design phase to define the sequence of lithographic, etching and deposition steps for translating masking patterns into specific topographical patterns in conductors, dielectrics or semiconductor material.

#### Note

1034.3. does not embargo "software" specially designed for schematic entry, logic simulation, placing and routing, layout verification or pattern generation tape;

#### N.B.

Libraries, design attributes or associated data for the design of semiconductor devices or integrated circuits are considered as technology.

### 1035. Technology

1. Technology according to the General Technology Note for the "development" or "production" of equipment or materials embargoed by 1031, 1032 or 1033;

#### Note

1035.1. does not embargo technology for the "development" or "production" of:

- a. Microwave transistors operating at frequencies below 31 GHz;
- b. Integrated circuits embargoed by 1031.1.a.3. to 12., having both of the following:
  1. Using technology of one  $\mu\text{m}$  or more, and
  2. Not incorporating multi-layer structures.

#### N.B.:

This Note does not preclude the export of multilayer technology for devices incorporating a maximum of two metal layers and two polysilicon layers.

2. Other technology for the "development" or "production" of:
  - a. Vacuum microelectronic devices;
  - b. Hetero-structure semiconductor devices such as high electron mobility transistors (HEMT), hetero-bipolar transistors (HBT), quantum well or super lattice devices;
  - c. "Superconductive" electronic devices;
  - d. Substrates of films of diamond for electronic components.

## 1040. Computers

### Note 1:

Computers, related equipment or "software" performing telecommunications or "local area network" functions must also be evaluated against the performance characteristics of Category 1050 (Telecommunications).

### N.B.:

- Control units which directly interconnect the buses or channels of central processing units, "main storage" or disk controllers are not regarded as telecommunications equipment described in Category 1050 (Telecommunications).
- For the embargo status of "software" which provides routing or switching of "datagram" or "fast select" packets (i.e. packet by packet route selection) or of "software" specially designed for packet switching, see Category 1054 (Telecommunications).

### Note 2:

Computers, related equipment or "software" performing cryptographic, cryptanalytic, certifiable multi-level security or certifiable user isolation functions, or which limit electromagnetic compatibility (EMC), must also be evaluated against the performance characteristics in Category 1151 ("Information Security").

## 1041. Equipment, Assemblies and Components

- Electronic computers and related equipment, as follows, and "assemblies" and specially designed components therefor:
    - Specially designed to have either of the following characteristics:
      - Rated for operation at an ambient temperature below 228 K (-45°C) or above 358 K (85°C);

**Note:**  
1041.1.a.1. does not apply to computers specially designed for civil automobile or railway train applications.
  - Radiation hardened to exceed any of the following specifications:
    - Total Dose  $5 \times 10^5$  Rads (Si)
    - Dose Rate Upset  $5 \times 10^8$  Rads (Si)/sec; **or**
    - Single Event Upset  $1 \times 10^{-7}$  Error/bit/day;(For equipment designed or rated for transient ionising radiation, see the Munitions List.)
  - Having characteristics or performing functions exceeding the limits in Category 1150 ("Information Security");
- "Hybrid computers", as follows, and "assemblies" and specially designed components therefor:
  - Containing "digital computers" embargoed by 1041.3.;
  - Containing analogue-to-digital converters having both of the following characteristics:
    - 32 channels or more; **and**
    - A resolution of 14 bits (plus sign bit) or more with a conversion rate of 200,000 conversions/s or more;
- "Digital computers", "assemblies", and related equipment therefor, as follows, and specially designed components therefor:

### Notes:

- 1041.3. includes vector processors, array processors, digital signal processors, logic processors, and equipment for "image enhancement" or "signal processing".
- The embargo status of the "digital computers" or related equipment described in 1041.3 is governed by the embargo status of other equipment or systems provided:
  - The "digital computers" or related equipment are essential for the operation of the other equipment or systems;
  - The "digital computers" or related equipment are not a "principal element" of the other equipment or systems; **and**

### N.B.:

- The embargo status of "signal processing" or "image enhancement" equipment specially designed for other equipment with functions limited to those required for the other equipment is determined by the embargo status of the other equipment even if it exceeds the "principal element" criterion.
- For the embargo status of "digital computers" or related equipment for telecommunications equipment, see Category 5 (Telecommunications).

- The technology for the "digital computers" and related equipment is governed by 1045.

- Designed or modified for "fault tolerance";

### Note:

For the purposes of 1041.3.a., "digital computers" and related equipment are not considered to be designed or modified for "fault tolerance" if they use:

- Error detection or correction algorithms in "main storage";
  - 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;
  - 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**
  - 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.
- "Digital computers" having a "CTP" exceeding 260 Mtops;
  - "Assemblies" specially designed or modified to be capable of enhancing performance by aggregation of "computing elements" ("CEs") so that the "CTP" of the aggregation exceeds the limit in 1041.3.b.

### Notes:

- 1041.3.c. applies only to "assemblies" and programmable interconnections not exceeding the limit in 1041.3.b. when shipped as unintegrated "assemblies". It does not apply to "assemblies" inherently limited by nature of their design for use as related equipment embargoed by 1041.3.d., e. or f.
  - 1041.3.c. does not embargo "assemblies" specially designed for a product or family of products whose maximum configuration does not exceed the limit of 1041.3.b.
- Graphics accelerators or graphics coprocessors exceeding a "three dimensional (3 -D) vector rate" of 1,600,000;
  - Equipment performing analogue-to-digital conversions exceeding the limits in 1031.1.a.5.;
  - Equipment containing "terminal interface equipment" exceeding the limits in 1051.b.3.;
- Note:**  
For the purposes of 1041.3.f. "terminal interface equipment" includes "local area network" interfaces, modems and other communications interfaces. "Local area network" interfaces are evaluated as "network access controllers".
- Equipment specially designed to provide for the external interconnection of "digital computers" or associated equipment which allows communications at data rates exceeding 80 Mbyte/s.

### Notes:

- 1041.3.g. does not embargo internal interconnection equipment (e.g. backplanes, buses) or passive interconnection equipment
  - Governments may permit the export of equipment embargoed by 1041.3.g. provided it is exported for use in interconnecting peripheral equipment to "digital computers" not embargoed by 1041.3.b.
- Computers, as follows, and specially designed related equipment, "assemblies" and components therefor:
    - "Systolic array computers";
    - "Neural computers";
    - "Optical computers";

## 1042. Test, Inspection and Production Equipment

None

## 1043. Materials

None

## 1044. Software

### Note:

The embargo status of "software" for the "development", "production", or "use" of equipment described in other Categories is dealt with in the appropriate Category. The embargo status of "software" for equipment described in this Category is dealt with herein.

1. "Software" specially designed or modified for the "development", "production" or "use" of equipment or "software" embargoed by 1041 or 1044;
2. "Software" specially designed or modified to support "technology" embargoed by 1045;
3. Specific "software", as follows:
  - a. Operating system "software", "software" development tools and compilers specially designed for "multi-data-stream processing" equipment, in "source code";
  - b. "Expert systems" or "software" for "expert system" inference engines providing both:
    1. Time dependent rules; **and**
    2. Primitives to handle the time characteristics of the rules and the facts;
  - c. "Software" having characteristics or performing functions exceeding the limits in Category 5 ("Information Security");
  - d. Operating systems specially designed for "real time processing" equipment which guarantees a "global interrupt latency time" of less than 20  $\mu$ s;

## 1045. Technology

1. "Technology" according to the General Technology Note, for the "development", "production" or "use" of equipment or "software" embargoed by 1041 or 1044;
2. Other "technology", as follows:
  - a. "Technology" for the "development" or "production" of equipment designed for "multi-data-stream processing" where the "CTP" exceeds 120 Mtops;
  - b. Technology "required" for the "development" or "production" of magnetic hard disk drives with an "MBTR" exceeding 47 Mbit/s.

### Technical Note on "Composite Theoretical Performance" ("CTP"):

Abbreviations used in this Technical Note:

"CE"	"computing element" (typically an arithmetic logical unit)
FP	floating point
XP	fixed point
t	execution time
XOR	exclusive OR
CPU	central processing unit
TP	theoretical performance (of a single "CE")
"CTP"	"composite theoretical performance" (multiple "CEs")
R	effective calculating rate
WL	word length
L	word length adjustment
*	multiply

Execution time "t" is expressed in microseconds, TP and "CTP" are expressed in millions of theoretical operations per second (Mtops) and WL is expressed in bits.

### Outline of "CTP" Calculation Method

"CTP" is a measure of computational performance given in Mtops. In calculating the "CTP" of an aggregation of "CEs" the following three steps are required:

1. Calculate the effective calculating rate R for each "CE";
2. Apply the word length adjustment (L) to the effective calculating rate (R), resulting in a Theoretical Performance (TP) for each "CE";
3. If there is more than one "CE", combine the TPs, resulting in a "CTP" for the aggregation.

Details for these steps are given in the following sections.

#### Note 1:

For aggregations of multiple "CEs" which have both shared and unshared memory subsystems, the calculation of "CTP" is completed hierarchically, in two steps: first, aggregate the groups of "CEs" sharing memory; second, calculate the "CTP" of the groups using the calculation method for multiple "CEs" not sharing memory.

#### Note 2:

"CEs" that are limited to input/output and peripheral functions (e.g. disk drive, communication and video display controllers) are not aggregated into the "CTP" calculation.

**Technical Note on "CTP":**

The following table shows the method of calculating the Effective Calculating Rate R for each "CE":

**Step 1: The Effective Calculating Rate R:**

For "CEs" Implementing: <b>Note:</b> Every "CE" must be evaluated independently	Effective calculating Rate, R
XP only (R <sub>xp</sub> )	$\frac{1}{3 \times (t_{xp \text{ add}})}$ if no add is implemented use: $\frac{1}{(t_{xp \text{ mult}})}$ if neither add nor multiply is implemented use the fastest available arithmetic operation as follows: $\frac{1}{3 \times t_{xp}}$ See Notes X & Z
FP only (R <sub>fp</sub> )	Max $\frac{1}{t_{fp \text{ add}}}, \frac{1}{t_{fp \text{ mult}}}$ See Notes X & Y
Both FP and XP (R)	Calculate both R <sub>xp</sub> , R <sub>fp</sub>
For simple logic processors not implementing any of the specified arithmetic operations.	$\frac{1}{3 \times t_{\text{log}}}$ Where t <sub>log</sub> is the execute time of the XOR, or for logic hardware not implementing the XOR, the fastest simple logic operation. See Notes X & Z
For special logic processors not using any of the specified arithmetic or logic operations.	R = R' × WL/64 Where R' is the number of results per second, WL is the number of bits upon which the logic operation occurs, and 64 is a factor to normalize to a 64 bit operation.

**Note W:**

For a pipelined "CE" capable of executing up to one arithmetic or logic operation every clock cycle after the pipeline is full, a pipelined rate can be established. The effective calculating rate (R) for such a "CE" is the faster of the pipelined rate or non-pipelined execution rate.

**Note X:**

For a "CE" which performs multiple operations of a specific type in a single cycle (e.g. two additions per cycle or two identical logic operations per cycle), the execution time t is given by:

$$t = \frac{\text{cycle time}}{\text{the number of identical operations per machine cycle}}$$

"CEs" which perform different types of arithmetic or logic operations in a single machine cycle are to be treated as multiple separate "CEs" performing simultaneously (e.g. a "CE" performing an addition and a multiplication in one cycle is to be treated as two "CEs", the first performing an addition in one cycle and the second performing a multiplication in one cycle).

If a single "CE" has both scalar function and vector function, use the shorter execution time value.

**Note Y:**

For the "CE" that does not implement FP add or FP multiply, but that performs FP divide:

$$R_{fp} = \frac{1}{t_{fp \text{ divide}}}$$

If the "CE" implements FP reciprocal but not FP add, FP multiply or FP divide, then

$$R_{fp} = \frac{1}{t_{fp \text{ reciprocal}}}$$

If none of the specified instructions is implemented, the effective FP rate is 0.

**Note Z:**

In simple logic operations, a single instruction performs a single logic manipulation of no more than two operands of given lengths.

In complex logic operations, a single instruction performs multiple logic manipulations to produce one or more results from two or more operands.

Rates should be calculated for all supported operand lengths considering both pipelined operations (if supported), and non-pipelined operations using the fastest executing instruction for each operand length based on:

1. Pipelined or register-to-register operations. Exclude extraordinarily short execution times generated for operations on a predetermined operand or operands (for example, multiplication by 0 or 1). If no register-to-register operations are implemented, continue with (2).
2. The faster of register-to-memory or memory-to-register operations; if these also do not exist, then continue with (3).
3. Memory-to-memory.

In each case above, use the shortest execution time certified by the manufacturer.

1045. cont'd.

**Step 2: TP for each supported operand length WL:**

Adjust the effective rate R (or R') by the word length adjustment L as follows:

$$TP = R \times L, \text{ where } L = (1/3 + WL/96)$$

**Note:**

The word length WL used in these calculations is the operand length in bits. (If an operation uses operands of different lengths, select the largest word length.)

The combination of a mantissa ALU and an exponent ALU of a floating point processor or unit is considered to be one "CE" with a Word Length (WL) equal to the number of bits in the data representation (typically 32 or 64) for purposes of the "CTP" calculation. This adjustment is not applied to specialized logic processors which do not use XOR instructions. In this case TP = R.

Select the maximum resulting value of TP for:

Each XP-only "CE" ( $R_{xp}$ );

Each FP-only "CE" ( $R_{fp}$ );

Each combined FP and XP "CE" (R);

Each simple logic processor not implementing any of the specified arithmetic operations; and

Each special logic processor not using any of the specified arithmetic or logic operations.

**Step 3: "CTP" for aggregations of "CEs", including CPUs.**

For a CPU with a single "CE",

$$\text{"CTP"} = TP$$

(for "CEs" performing both fixed and floating point operations

$$TP = \max(TP_{fp}, TP_{xp})$$

"CTP" for aggregations of multiple "CEs" operating simultaneously is calculated as follows:

**Notes:**

1. For aggregations that do not allow all of the "CEs" to run simultaneously, the possible combination of "CEs" that provides the largest "CTP" should be used. The TP of each contributing "CE" is to be calculated at its maximum value theoretically possible before the "CTP" of the combination is derived.

**N.B.:**

To determine the possible combinations of simultaneously operating "CEs", generate an instruction sequence that initiates operations in multiple "CEs", beginning with the slowest "CE" (the one needing the largest number of cycles to complete its operation) and ending with the fastest "CE". At each cycle of the sequence, the combination of "CEs" that are in operation during that cycle is a possible combination. The instruction sequence must take into account all hardware and/or architectural constraints on overlapping operations.

2. A single integrated circuit chip or board assembly may contain multiple "CEs".
3. Simultaneous operations are assumed to exist when the computer manufacturer claims concurrent, parallel or simultaneous operation or execution in a manual or brochure for the computer.
4. "CTP" values are not to be aggregated for "CE" combinations (inter)connected by "Local Area Networks", Wide Area Networks, I/O shared connections/devices, I/O controllers and any communication interconnection implemented by software.
5. "CTP" values must be aggregated for multiple "CEs" specially designed to enhance performance by aggregation, operating simultaneously and sharing memory, or multiple memory/"CE" combinations operating simultaneously utilising specially designed hardware.

This aggregation does not apply to "assemblies" described by 1041.3.d.

$$\text{"CTP"} = TP_1 + C_2 \times TP_2 + \dots + C_n \times TP_n,$$

where the  $TP_i$  are ordered by value, with  $TP_1$  being the highest,  $TP_2$  being the second highest, ..., and  $TP_n$  being the lowest.  $C_i$  is a coefficient determined by the strength of the interconnection between "CEs", as follows:

For multiple "CEs" operating simultaneously and sharing memory:

$$C_2 = C_3 = C_4 = \dots = C_n = 0.75$$

**Notes:**

1. When the "CTP" calculated by the above method does not exceed 194 Mtops, the following formula may be used to calculate  $C_i$ :

$$C_i = \frac{0.75}{\sqrt{m}} \quad (i = 2, \dots, n)$$

where m = the number of "CEs" or groups of "CEs" sharing access provided:

- a. The  $TP_i$  of each "CE" or group of "CEs" does not exceed 30 Mtops;
- b. The "CEs" or groups of "CEs" share access to main memory (excluding cache memory) over a single channel; and

- c. Only one "CE" or group of "CEs" can have use of the channel at any given time.

**N.B.:**

This does not apply to items controlled under Category 1030.

2. "CEs" share memory if they access a common segment of solid state memory. This memory may include cache memory, main memory or other internal memory. Peripheral memory devices such as disk drives, tape drives or RAM disks are not included.

For Multiple "CEs" or groups of "CEs" not sharing memory, interconnected by one or more data channels:

$$\begin{aligned} C_i &= 0.75 \times k_i \quad (i = 2, \dots, 32) \text{ (see Note below)} \\ &= 0.60 \times k_i \quad (i = 33, \dots, 64) \\ &= 0.45 \times k_i \quad (i = 65, \dots, 256) \\ &= 0.30 \times k_i \quad (i > 256) \end{aligned}$$

The value of  $C_i$  is based on the number of "CE"s, not the number of nodes.

where  $k_i = \min(S_i/K_n, 1)$ , and

$K_n =$  normalizing factor of 20 MByte/s.

$S_i =$  sum of the maximum data rates (in units of MByte/s) for all data channels connected to the  $i^{\text{th}}$  "CE" or group of "CEs" sharing memory.

When calculating a  $C_i$  for a group of "CEs", the number of the first "CE" in a group determines the proper limit for  $C_i$ . For example, in an aggregation of groups consisting of 3 "CEs" each, the 22nd group will contain "CE"<sub>64</sub>, "CE"<sub>65</sub> and "CE"<sub>66</sub>. The proper limit for  $C_i$  for this group is 0.60.

Aggregation (of "CEs" or groups of "CEs") should be from the fastest-to-slowest; i.e.:

$$TP_1 \geq TP_2 \geq \dots \geq TP_n, \text{ and in the case of } TP_i = TP_{i+1}, \text{ from the largest to smallest; i.e.: } C_i \geq C_{i+1}$$

**Note:**

The  $k_i$  factor is not to be applied to "CEs" 2 to 12 if the  $TP_i$  of the "CE" or group of "CEs" is more than 50 Mtops; i.e.  $C_i$  for "CEs" 2 to 12 is 0.75.

## 1050. Telecommunications

**Notes:**

1. The embargo status of components, "lasers", test and production equipment, materials and "software" therefor which are specially designed for telecommunications equipment or systems is defined in this Category.
2. "Digital computers", related equipment or "software", when essential for the operation and support of telecommunications equipment described in this Category, are regarded as specially designed components, provided they are the standard models customarily supplied by the manufacturer. This includes operation, administration, maintenance, engineering or billing computer systems.

### 1051. Equipment, Assemblies and Components

- a. Any type of telecommunications equipment having any of the following characteristics, functions or features:
  1. Specially designed to withstand transitory electronic effects or electromagnetic pulse arising from a nuclear explosion;
  2. Specially hardened to withstand gamma, neutron or ion radiation;
  3. Specially designed to operate outside the temperature range from 218 K (-55°C) to 397 K (124°C);

**Notes:**

1. 1051.a.3. applies only to electronic equipment.
2. 1051.a.2. and 3. do not apply to equipment on board satellites.
- b. Telecommunication transmission equipment or systems, and specially designed components and accessories therefor, having any of the following characteristics, functions or features:

**Note:**

Telecommunication transmission equipment:

- a. Categorized as follows, or combinations thereof:
  1. Radio equipment (e.g. transmitters, receivers and transceivers);
  2. Line terminating equipment;
  3. Intermediate amplifier equipment;
  4. Repeater equipment;
  5. Regenerator equipment;
  6. Translation encoders (transcoders);
  7. Multiplex equipment (statistical multiplex included);

1051. cont'd.

8. Modulators/demodulators (modems);
  9. Transmultiplex equipment (see CCITT Rec. G701);
  10. "Stored programme controlled" digital crossconnection equipment;
  11. "Gateways" and bridges;
  12. "Media access units"; **and**
- b. Designed for use in single or multi-channel communication via:
1. Wire (line);
  2. Coaxial cable;
  3. Optical fibre cable;
  4. Electromagnetic radiation;
  5. Underwater acoustic wave propagation.
1. Employing digital techniques, including digital processing of analogue signals, and designed to operate at a "digital transfer rate" at the highest multiplex level exceeding 45 Mbit/s or a "total digital transfer rate" exceeding 90 Mbit/s;

**Note:**

1051.b.1. does not embargo equipment specially designed to be integrated and operated in any satellite system for civil use.

2. Being "stored programme controlled" digital cross connect equipment with a "digital transfer rate" exceeding 8.5 Mbit/s per port;
3. Being equipment containing:
  - a. Modems using the "bandwidth of one voice channel" with a "data signalling rate" exceeding 28,800 bit/s;
  - b. "Communication channel controllers" with a digital output having a "data signalling rate" exceeding 64,000 bit/s per channel; or
  - c. "Network access controllers" and their related common medium having a "digital transfer rate" exceeding 33 Mbit/s;

**Note:**

If any unembargoed equipment contains a "network access controller", it cannot have any type of telecommunications interface except those described in, but not embargoed by 1051.b.3.

4. Employing a "laser" and having any of the following characteristics:
  - a. A transmission wavelength exceeding 1,000 nm;
  - b. Employing analogue techniques and having a bandwidth exceeding 45 MHz;
  - c. Employing coherent optical transmission or coherent optical detection techniques (also called optical heterodyne or homodyne techniques);
  - d. Employing wavelength division multiplexing techniques; or
  - e. Performing "optical amplification";
5. Being radio equipment operating at input or output frequencies exceeding:
  - a. 31 GHz for satellite-earth station applications;
  - b. 26.5 GHz for other applications;

**Note:**

1051.b.5.b. does not embargo equipment for civil use conforming with an ITU allocated band between 26.5 and 31 GHz.

6. Being radio equipment:
    - a. Employing quadrature-amplitude-modulation (QAM) techniques above level 4 if the "total digital transfer rate" exceeds 8.5 Mbit/s;
    - b. Employing QAM techniques above level 16 if the "total digital transfer rate" is equal to or less than 8.5 Mbit/s; or
    - c. Employing other digital modulation techniques and having a "spectral efficiency" exceeding 3 bit/sec/Hz;
- Notes:**
1. 1051.b.6. does not embargo equipment specially designed to be integrated and operated in any satellite system for civil use.
  2. 1051.b.6. does not embargo radio relay equipment for operation in an ITU allocated band:
    - a. 1. Not exceeding 960 MHz; **or**
    2. With a "total digital transfer rate" not exceeding 8.5 Mbit/s; **and**
    - b. Having a "spectral efficiency" not exceeding 4 bit/sec/Hz;
  7. Being radio equipment operating in the 1.5 to 87.5 MHz band and having either of the following characteristics:
    - a. 1. Automatically predicting and selecting frequencies and "total digital transfer rates" per channel to optimize the transmission; **and**

2. Incorporating a linear power amplifier configuration having a capability to support multiple signals simultaneously at an output power of 1 kW or more in the 1.5 to 30 MHz frequency range or 250 W or more in the 30 to 87.5 MHz frequency range, over an "instantaneous bandwidth" of one octave or more and with an output harmonic and distortion content of better than -80 dB; **or**
- b. Incorporating adaptive techniques providing more than 15 dB suppression of an interfering signal;
8. Being radio equipment employing "spread spectrum" or "frequency agility" (frequency hopping) techniques having either of the following characteristics:
  - a. User programmable spreading codes; or
  - b. A total transmitted bandwidth which is 100 or more times the bandwidth of any one information channel and in excess of 50 kHz;
9. Being digitally controlled radio receivers having more than 1,000 channels, which:
  - a. Search or scan automatically a part of the electromagnetic spectrum;
  - b. Identify the received signals or the type of transmitter; **and**
  - c. Have a "frequency switching time" of less than 1 ms
10. Providing functions of digital "signal processing" as follows:
  - a. Voice coding at rates of less than 2,400 bit/s;
  - b. Employing circuitry which incorporates "user-accessible programmability" of digital "signal processing" circuits exceeding the limits of 1041.3.g.
11. Being underwater communications systems having any of the following characteristics:
  - a. An acoustic carrier frequency outside the range from 20 to 60 kHz;
  - b. Using an electromagnetic carrier frequency below 30 kHz; **or**
  - c. Using electronic beam steering techniques;
- c. "Stored programme controlled" switching equipment and related signalling systems, having any of the following characteristics, functions or features, and specially designed components and accessories therefor:

**Note:**

Statistical multiplexers with digital input and digital output which provide switching are treated as "stored programme controlled" switches.

1. "Common channel signalling";

**Note:**

Signalling systems in which the signalling channel is carried in and refers to no more than 32 multiplexed channels forming a trunk line of no more than 2.1 Mbit/s, and in which the signalling information is carried in a fixed, time division multiplexed channel without the use of labelled messages, are not considered to be "common channel signalling" systems.

2. Containing "Integrated Services Digital Network" ("ISDN") functions and having either of the following:
  - a. Switch-terminal (e.g. subscriber line) interfaces with a "digital transfer rate" at the highest multiplex level exceeding 192,000 bit/s, including the associated signalling channel (e.g. 2B+D); or
  - b. The capability that a signalling message received by a switch on a given channel that is related to a communication on another channel may be passed through to another switch;

**Note:**

1051.c.2. does not preclude:

1. The evaluation and appropriate actions taken by the receiving switch;
  2. Unrelated user message traffic on a D channel of "ISDN".
3. Multi-level priority and pre-emption for circuit switching;

**Note:**

1051.c.3. does not embargo single-level call pre-emption.

4. "Dynamic adaptive routing";
5. Routing or switching of "datagram" packets;
6. Routing or switching of "fast select" packets;

**Note:**

The restrictions in 1051.c.5. and 6. do not apply to networks using only "network access controllers" or to "network access controllers" themselves.

7. Designed for automatic hand-off of cellular radio calls to other cellular switches or for automatic connection to a centralized subscriber data base common to more than one switch;

### 1051. cont'd.

c. 8. Being packet switches, circuit switches and routers with ports or lines exceeding either:

- a. A "data signalling rate" of 64,000 bit/s per channel for a "communications channel controller"; or

**Note:**

*1051.c.8.a. does not preclude the multiplexing over a composite link of communications channels not embargoed by 1051.c.8.a.*

- b. A "digital transfer rate" of 33 Mbit/s for a "network access controller" and related common medium;
  9. "Optical switching";
  10. Employing "Asynchronous Transfer Mode" ("ATM") techniques;
  11. Containing "stored programme controlled" digital crossconnect equipment with a "digital transfer rate" exceeding 8.5 Mbit/s per port;
- d. Centralized network control having both of the following characteristics:
1. Receives data from the nodes; and
  2. Processes these data in order to provide control of traffic not requiring operator decisions, thereby performing "dynamic adaptive routing";

**Note:**

*1051.d. does not preclude control of traffic as a function of predictable statistical traffic conditions.*

e. Optical fibre communication cables, optical fibres and accessories, as follows:

1. Optical fibres or cables of more than 50 m in length having either of the following characteristics:

- a. Designed for single mode operation; or
- b. For optical fibres, specified by the manufacturer as being capable of withstanding a proof test tensile stress of  $2 \times 10^9$  N/m<sup>2</sup> or more;

**Technical Note:**

*Proof Test: on-line or off-line production screen testing that dynamically applies a prescribed tensile stress over a 0.5 to 3 m length of fibre at a running rate of 2 to 5 m/s while passing between capstans approximately 150 mm in diameter. The ambient temperature is a nominal 293 K and relative humidity 40%.*

**N.B.** *Equivalent national standards may be used for executing the proof test*

2. Optical fibre cables and accessories designed for underwater use; (For fibre-optic hull penetrators or connectors, see 1081.2.c.)
- f. Phased array antennae, operating above 10.5 GHz, containing active elements and distributed components, and designed to permit electronic control of beam shaping and pointing, except those for landing systems with instruments meeting ICAO standards (microwave landing systems (MLS)).

### 1052. Test, Inspection and Production Equipment

- a. Equipment, and specially designed components and accessories therefor, specially designed for:
  1. Development of equipment, materials, functions or features embargoed by 1051., 1052., 1053., 1054. or 1055., including measuring or test equipment;
  2. Production of equipment, materials, functions or features embargoed by 1051., 1052., 1053., 1054. or 1055., including measuring, test or repair equipment;
  3. Use of equipment, materials, functions or features exceeding any of the least stringent embargo criteria applicable in 1051., 1052., 1053., 1054. or 1055., including measuring, test or repair equipment;

**Note:**

*1052.a. does not embargo optical fibres and "optical fibre preform" characterization equipment not using semiconductor "lasers".*

- b. Other equipment as follows:
  1. Bit error rate (BER) test equipment designed or modified to test the equipment embargoed in 1051.b.1.;
  2. Data communication protocol analyzers, testers and simulators specially designed for functions embargoed by 1051.;
  3. Stand alone "stored programme controlled" radio transmission media simulators/channel estimators specially designed for testing equipment embargoed by 1051.b.5.

### 1053. Materials

Preforms of glass or of any other material optimized for the manufacture of optical fibres embargoed by 1051.e.

### 1054. Software

- a. "Software" specially designed or modified for the "development", "production" or "use" of equipment or materials embargoed by 1051., 1052. or 1053.
- b. "Software" specially designed or modified to support "technology" embargoed by 1055.;
- c. Specific "software" as follows:
  1. "Generic software", other than in machine-executable form, specially designed or modified for the "use" of "stored programme controlled" digital switching equipment or systems;
  2. "Software", other than in machine-executable form, specially designed or modified for the "use" of digital cellular radio equipment or systems;
  3. "Software" specially designed or modified to provide characteristics, functions or features of equipment embargoed by 1051. or 1052.;
  4. "Software" which provides the capability of recovering "source code" of telecommunications "software" embargoed by this Category;
  5. "Software" specially designed for the "development" or "production" of "software" embargoed by 1054. (For "software" for "signal processing" see also 1044. and 1064.)

### 1055. Technology

- a. Technology according to the General Technology Note for the "development", "production" or "use" (excluding operation) of equipment, systems, materials or "software" embargoed by 1051., 1052., 1053. or 1054.;
- b. Specific technologies, as follows:
  1. "Required" technology for the "development" or "production" of telecommunications equipment specially designed to be used on board satellites;
  2. Technology for the "development" or "use" of "laser" communication techniques with the capability of automatically acquiring and tracking signals and maintaining communications through exoatmosphere or sub-surface (water) media;
  3. Technology for the processing and application of coatings to optical fibre specially designed to make it suitable for underwater use;
  4. Technology for the "development" or "production" of equipment employing "Synchronous Digital Hierarchy" ("SDH") or "Synchronous Optical Network" ("SONET") techniques;
  5. Technology for the "development" or "production" of "switch fabric" exceeding 64,000 bit/s per information channel other than for digital cross connect integrated in the switch;
  6. Technology for the "development" or "production" of centralized network control;
  7. Technology for the "development" or "production" of digital cellular radio systems;
  8. Technology for the "development" or "production" of "Integrated Services Digital Network" ("ISDN").
  9. Technology for the "development" of QAM techniques, for radio equipment, above level 4.

## 1150. Information Security

**Note:**

*The embargo status of "information security" equipment, "software", systems, application specific "assemblies", modules, integrated circuits, components or functions is defined in this Category even if they are components or "assemblies" of other equipment.*

### 1151. Equipment, Assemblies and Components

Systems, equipment, application specific "assemblies", modules or integrated circuits for "information security", as follows, and other specially designed components therefor:

- a. Designed or modified to use "cryptography" employing digital techniques to ensure "information security";
- b. Designed or modified to perform cryptanalytic functions;
- c. Designed or modified to use "cryptography" employing analogue techniques to ensure "information security", except:

### 1151. cont'd.

- c. 1. Equipment using "fixed" band scrambling not exceeding 8 bands and in which the transpositions change not more frequently than once every second;
2. Equipment using "fixed" band scrambling exceeding 8 bands and in which the transpositions change not more frequently than once every ten seconds;
3. Equipment using "fixed" frequency inversion and in which the transpositions change not more frequently than once every second;
4. Facsimile equipment;
5. Restricted audience broadcast equipment;
6. Civil television equipment;
- d. Designed or modified to suppress the compromising emanations of information-bearing signals;

**Note:**

1151.d. does not embargo equipment specially designed to suppress emanations for health or safety reasons.

- e. Designed or modified to use cryptographic techniques to generate the spreading code for "spread spectrum" or the hopping code for "frequency agility" systems;
- f. Designed or modified to provide certified or certifiable "multilevel security" or user isolation at a level exceeding Class B2 of the Trusted Computer System Evaluation Criteria (TCSEC) or equivalent;
- g. Communications cable systems designed or modified using mechanical, electrical or electronic means to detect surreptitious intrusion.

**Note:**

1151. does not embargo:

- a. "Personalized smart cards" using "cryptography";
- b. Equipment containing "fixed" data compression or coding techniques;
- c. Receiving equipment for radio broadcast, pay television or similar restricted audience television of the consumer type, without digital encryption and where digital decryption is limited to the video, audio or management functions;
- d. Portable (personal) or mobile radiotelephones for civil use, e.g. for use with commercial civil cellular radiocommunications systems, containing encryption, when accompanying their users;
- e. Decryption functions specially designed to allow the execution of copy-protected "software", provided the decryption functions are not user-accessible.

### 1152. Test, Inspection and Production Equipment

- a. Equipment specially designed for:
  1. The development of equipment or functions embargoed by 1151., 1152., 1154. or 1155., including measuring or test equipment;
  2. The production of equipment or functions embargoed by 1151., 1152., 1154. or 1155., including measuring, test, repair or production equipment;
- b. Measuring equipment specially designed to evaluate and validate the "information security" functions embargoed by 1151. or 1154.

### 1153. Materials

None

### 1154. Software

- a. "Software" specially designed or modified for the "development", "production" or "use" of equipment or "software" embargoed by 1151., 1152. or 1154.;
- b. "Software" specially designed or modified to support technology embargoed by 1155.;
- c. Specific "software" as follows:
  1. "Software" having the characteristics, or performing or simulating the functions of the equipment embargoed by 1151. or 1152.;
  2. "Software" to certify "software" embargoed by 1154.c.1.;
  3. "Software" designed or modified to protect against malicious computer damage, e.g. viruses.

**Note:**

1154. does not embargo:

- a. "Software" required for the "use" of equipment excluded from embargo under the Note to 1151.;
- b. "Software" providing any of the functions of equipment excluded from embargo under the Note to 1151.

### 1155. Technology

Technology according to the General Technology Note for the "development", "production" or "use" of equipment or "software" embargoed by 1151., 1152 or 1154.

## 1060. Sensors and Lasers

### 1061. Equipment, Assemblies and Components

#### 1. Acoustics

- a. Marine acoustic systems, equipment and specially designed components therefor, as follows:

1. Active (transmitting or transmitting-and-receiving) systems, equipment and specially designed components therefor, as follows:

**Note:**

1061.1.a.1. does not embargo:

- a. Depth sounders operating vertically below the apparatus, not including a scanning function exceeding  $\pm 10^\circ$ , and limited to measuring the depth of water, the distance of submerged or buried objects or fish finding;

- b. Acoustic beacons, as follows:

1. Acoustic emergency beacons; or
2. Pingers specially designed for relocating or returning to an underwater position.

1. a. Wide-swath bathymetric survey systems for sea bed topographic mapping:

1. Designed:

- a. To take measurements at an angle exceeding  $10^\circ$  from the vertical; and
- b. To measure depths exceeding 600 m below the water surface; and

2. Designed:

- a. To incorporate multiple beams any of which is less than  $2^\circ$ ; or
- b. To provide data accuracies of better than 0.5% of water depth across the swath averaged over the individual measurements within the swath;

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

1. A transmitting frequency below 10 kHz;
2. Sound pressure level exceeding 224 dB (reference  $1 \mu\text{Pa}$  at 1 m) for equipment with an operating frequency in the band from 10 kHz to 24 kHz inclusive;
3. Sound pressure level exceeding 235 dB (reference  $1 \mu\text{Pa}$  at 1 m) for equipment with an operating frequency in the band between 24 kHz and 30 kHz;
4. Forming beams of less than  $1^\circ$  on any axis and having an operating frequency of less than 100 kHz;
5. Designed to withstand pressure during normal operation at depths exceeding 1,000 m and having transducers:
  - a. Dynamically compensated for pressure; or
  - b. Incorporating other than lead zirconate titanate as the transduction element; or
6. Designed to operate with an unambiguous display range exceeding 5,120 m;

- c. Acoustic projectors, including transducers, incorporating piezoelectric, magnetostrictive, electrostrictive, electrodynamic or hydraulic elements operating individually or in a designed combination, having any of the following characteristics:

**Notes:**

1. The embargo status of acoustic projectors, including transducers, specially designed for other equipment is determined by the embargo status of the other equipment.
2. 1061.1.a.1.c. does not embargo electronic sources which direct the sound vertically only, or mechanical (e.g. air gun or vapour-shock gun) or chemical (e.g. explosive) sources.

- c. 1. An instantaneous radiated acoustic power density exceeding  $0.01 \text{ mW/mm}^2/\text{Hz}$  for devices operating at frequencies below 10 kHz;

1061. cont'd.

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

**Technical Note:**

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

3. Designed to withstand pressure during normal operation at depths exceeding 1,000 m; **or**
4. Side-lobe suppression exceeding 22 dB;
- d. Acoustic systems, equipment and specially designed components for determining the position of surface vessels or underwater vehicles designed:

**Note:**

1061.1.a.1.d. includes equipment using coherent "signal processing" between two or more beacons and the hydrophone unit carried by the surface vessel or underwater vehicle, or capable of automatically correcting speed-of-sound propagation errors for calculation of a point.

1. To operate at a range exceeding 1,000 m with a positioning accuracy of less than 10 m rms (root mean square) when measured at a range of 1,000 m; **or**
2. To withstand pressure at depths exceeding 1,000 m;
2. Passive (receiving, whether or not related in normal application to separate active equipment) systems, equipment and specially designed components therefor, as follows:
  - a. Hydrophones (transducers) having any of the following characteristics:
    1. Incorporating continuous flexible sensors or assemblies of discrete sensor elements with either a diameter or length less than 20 mm and with a separation between elements of less than 20 mm;
    2. Having any of the following sensing elements:
      - a. Optical fibres;
      - b. Piezoelectric polymers; **or**
      - c. Flexible piezoelectric ceramic materials;
    3. A hydrophone sensitivity better than -180 dB at any depth with no acceleration compensation;
    4. When designed to operate at depths not exceeding 35 m, a hydrophone sensitivity better than -186 dB with acceleration compensation;
    5. When designed for normal operation at depths exceeding 35 m, a hydrophone sensitivity better than -192 dB with acceleration compensation;
    6. When designed for normal operation at depths exceeding 100 m, a hydrophone sensitivity better than -204 dB; **or**
    7. Designed for operation at depths exceeding 1,000 m;

**Technical Note:**

Hydrophone sensitivity is defined as twenty times the logarithm to the base 10 of the ratio of rms output voltage to a 1 V rms reference, when the hydrophone sensor, without a pre-amplifier, is placed in a plane wave acoustic field with an rms pressure of 1 µPa. For example, a hydrophone of -160 dB (reference 1 V per µPa) would yield an output voltage of 10<sup>-9</sup> V in such a field, while one of -180 dB sensitivity would yield only 10<sup>-9</sup> V output. Thus, -160 dB is better than -180 dB.

2. b. Towed acoustic hydrophone arrays with any of the following:
  1. Hydrophone group spacing of less than 12.5 m;
  2. Hydrophone group spacing of 12.5 m to less than 25 m and designed or able to be modified to operate at depths exceeding 35 m;

**Technical Note:**

'Able to be modified' in 1061.1.a.2.b.2. means having provisions to allow a change of the wiring or interconnections to alter hydrophone group spacing or operating depth limits. These provisions are: spare wiring exceeding 10% of the number of wires, hydrophone group spacing adjustment blocks or internal depth limiting devices that are adjustable or that control more than one hydrophone group.

3. Hydrophone group spacing of 25 m or more and designed to operate at depths exceeding 100 m;
4. Heading sensors embargoed by 1061.1.a.2.d.;
5. Non-metallic strength members or longitudinally reinforced array hoses;
6. An assembled array of less than 40 mm in diameter;
7. Multiplexed hydrophone group signals; **or**
8. Hydrophone characteristics specified in 1061.1.a.2.a.;
- c. Processing equipment, specially designed for towed acoustic hydrophone arrays, with either of the following:
  1. A Fast Fourier or other transform of 1,024 or more complex points in less than 20 ms with no "user-accessible programmability"; **or**
  2. Time or frequency domain processing and correlation, including spectral analysis, digital filtering and beamforming using Fast Fourier or other transforms or processes with "user accessible programmability";
- d. Heading sensors having an accuracy of better than ± 0.5°; **and**
  1. Designed to be incorporated within the array hosing and to operate at depths exceeding 35 m or having an adjustable or removable depth sensing device in order to operate at depths exceeding 35 m; **or**
  2. Designed to be mounted external to the array hosing and having a sensor unit capable of operating with 360° roll at depths exceeding 35 m;
- b. Terrestrial geophones capable of conversion for use in marine systems, equipment or specially designed components embargoed by 1061.1.a.2.a.;
- c. Correlation-velocity sonar log equipment designed to measure the horizontal speed of the equipment carrier relative to the sea bed at distances between the carrier and the sea bed exceeding 500 m;

**2. Optical Sensors**

- a. Optical detectors, as follows:

**Note:**

1061.2.a. does not embargo germanium or silicon photodevices.

1. "Space-qualified" solid-state detectors having any of the following:
  - a. 1. A peak response in the wavelength range exceeding 10 nm but not exceeding 300 nm; **and**
  2. A response of less than 0.1% relative to the peak response at a wavelength exceeding 400 nm;
  - b. 1. A peak response in the wavelength range exceeding 900 nm but not exceeding 1,200 nm; **and**
  2. A response "time constant" of 95 ns or less; **or**
  - c. A peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm;
2. Image intensifier tubes and specially designed components therefor, as follows:
  - a. Image intensifier tubes having all of the following:
    1. A peak response in the wavelength range exceeding 400 nm but not exceeding 1,050 nm;
    2. A microchannel plate for electron image amplification with a hole pitch (centre-to-centre spacing) of less than 25 µm; **and**
    3. a. An S-20, S-25 or multialkali photocathode; **or**
    - b. A GaAs or GaInAs photocathode;
  - b. Specially designed components, as follows:
    1. Fibre optic image inverters;
    2. Microchannel plates having both of the following:
      - a. 15,000 or more hollow tubes per plate; **and**
      - b. Hole pitch (centre-to-centre spacing) of less than 25 µm;
    3. GaAs or GaInAs photocathodes;

1061. cont'd.

2. a. 3. Non-"space-qualified" "focal plane arrays", having any of the following:

**Technical Note:**

Linear or two-dimensional multi-element detector arrays are referred to as "focal plane arrays".

**Notes:**

1. 1061.2.a.3. includes photoconductive arrays and photovoltaic arrays.
2. 1061.2.a.3. does not embargo silicon "focal plane arrays", multi-element (not to exceed 16 elements) encapsulated photoconductive cells or pyroelectric detectors using any of the following:
  - a. Lead sulphide;
  - b. Triglycine sulphate and variants;
  - c. Lead-lanthanum-zirconium titanate and variants;
  - d. Lithium tantalate;
  - e. Polyvinylidene fluoride and variants;
  - f. Strontium barium niobate and variants; or
  - g. Lead selenide.
3. a. 1. Individual elements with a peak response within the wavelength range exceeding 900 nm but not exceeding 1,050 nm; **and**
  2. A response "time constant" of less than 0.5 ns;
- b. 1. Individual elements with a peak response in the wavelength range exceeding 1,050 nm but not exceeding 1,200 nm; **and**
  2. A response "time constant" of 95 ns or less; **or**
- c. Individual elements with a peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm;
4. Non-"space-qualified" single-element or non-focal-plane multi-element semiconductor photodiodes or phototransistors having both of the following:
  - a. A peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm; **and**
  - b. A response "time constant" of 0.5 ns or less;
- b. "Multispectral imaging sensors" designed for remote sensing applications, having either of the following:
  1. An Instantaneous-Field-Of-View (IFOV) of less than 200 microradians; **or**
  2. Specified for operation in the wavelength range exceeding 400 nm but not exceeding 30,000 nm; **and**
    - a. Providing output imaging data in digital format; **and**
    - b. 1. "Space-qualified"; **or**
    2. Designed for airborne operation, using other than silicon detectors, and having an IFOV of less than 2.5 milliradians;
- c. Direct view imaging equipment operating in the visible or infrared spectrum, incorporating either of the following:
  1. Image intensifier tubes embargoed by 1061.2.a.2.a.; **or**
  2. "Focal plane arrays" embargoed by 1061.2.a.3.;

**Technical Note:**

'Direct view' refers to imaging equipment, operating in the visible or infrared spectrum, that presents a visual image to a human observer without converting the image into an electronic signal for television display, and that cannot record or store the image photographically, electronically or by any other means.

**Note:**

1061.2.c. does not embargo the following equipment incorporating other than GaAs or GaInAs photocathodes:

- a. Industrial or civilian intrusion alarm, traffic or industrial movement control or counting systems;
  - b. Medical equipment;
  - c. Industrial equipment used for inspection, sorting or analysis of the properties of materials;
  - d. Flame detectors for industrial furnaces;
  - e. Equipment specially designed for laboratory use.
2. d. Special support components for optical sensors, as follows:
1. "Space-qualified" cryocoolers;
  2. Non-"space-qualified" cryocoolers, with a cooling source temperature below 218 K (-55°C), as follows:

- a. Closed cycle type with a specified Mean-Time-To-Failure (MTTF), or Mean-Time-Between-Failures (MTBF), exceeding 2,500 hours;
  - b. Joule-Thomson (JT) self-regulating minicoolers with bore (outside) diameters of less than 8 mm;
3. Optical sensing fibres:
- a. Specially fabricated either compositionally or structurally, or modified by coating, to be acoustically, thermally, inertially, electromagnetically or nuclear radiation sensitive; **or**
  - b. Modified structurally to have a "beat length" of less than 50 mm (high birefringence);

**3. Cameras**

(For cameras specially designed or modified for underwater use, see 1081.2.d. and 1081.2.e.)

- a. Instrumentation cameras, as follows:
1. High-speed cinema recording cameras using any film format from 8 mm to 16 mm inclusive, in which the film is continuously advanced throughout the recording period, and that are capable of recording at framing rates exceeding 13,150 frames per second;
- Note:**
- 1061.3.a.1. does not embargo cinema recording cameras for normal civil purposes.
2. Mechanical high speed cameras, in which the film does not move, capable of recording at rates exceeding 1,000,000 frames per second for the full framing height of 35 mm film, or at proportionately higher rates for lesser frame heights, or at proportionately lower rates for greater frame heights;
  3. Mechanical or electronic streak cameras with writing speeds exceeding 10 mm/ $\mu$ s;
  4. Electronic framing cameras having a speed exceeding 1,000,000 frames per second;
  5. Electronic cameras having:
    - a. An electronic shutter speed (gating capability) of less than 1  $\mu$ s per full frame; **and**
    - b. A read out time allowing a framing rate of more than 125 full frames per second;
- b. Imaging cameras, as follows:

**Note:**

1061.3.b. does not embargo television or video cameras specially designed for television broadcasting.

1. Video cameras incorporating solid state sensors, having any of the following:
  - a. More than  $4 \times 10^6$  "active pixels" per solid state array for monochrome (black and white) cameras;
  - b. More than  $4 \times 10^6$  "active pixels" per solid state array for colour cameras incorporating three solid state arrays; **or**
  - c. More than  $12 \times 10^6$  "active pixels" for solid state array colour cameras incorporating one solid state array;
2. Scanning cameras and scanning camera systems:
  - a. Incorporating linear detector arrays with more than 8,192 elements per array; **and**
  - b. Having mechanical scanning in one direction;
3. Incorporating image intensifiers embargoed by 1061.2.a.2.a.;
4. Incorporating "focal plane arrays" embargoed by 1061.2.a.3.;

**4. Optics**

- a. Optical mirrors (reflectors), as follows:
1. "Deformable mirrors" with either continuous or multi-element surfaces, and specially designed components therefor, capable of dynamically repositioning portions of the surface of the mirror at rates exceeding 100 Hz;
  2. Lightweight monolithic mirrors with an average "equivalent density" of less than 30 kg/m<sup>2</sup> and a total weight exceeding 10 kg;
  3. Lightweight "composite" or foam mirror structures with an average "equivalent density" of less than 30 kg/m<sup>2</sup> and a total weight exceeding 2 kg;
  4. Beam steering mirrors more than 100 mm in diameter or length of major axis which maintain a flatness of  $\lambda/2$  or better ( $\lambda$  is equal to 633 nm) with a control bandwidth exceeding 100 Hz;

1061. cont'd.

4. b. Optical components made from zinc selenide (ZnSe) or zinc sulphide (ZnS) with transmission in the wavelength range exceeding 3,000 nm but not exceeding 25,000 nm and either of the following:
  1. Exceeding 100 cm<sup>3</sup> in volume; **or**
  2. Exceeding 80 mm in diameter or length of major axis and 20 mm in thickness (depth);
- c. "Space-qualified" components for optical systems, as follows:
  1. Lightweighted to less than 20% "equivalent density" compared with a solid blank of the same aperture and thickness;
  2. Substrates, substrates with surface coatings (single-layer or multi-layer, metallic or dielectric, conducting, semiconducting or insulating) or with protective films;
  3. Segments or assemblies of mirrors designed to be assembled in space into an optical system with a collecting aperture equivalent to or larger than a single optic 1 metre in diameter;
  4. Manufactured from "composite" materials having a coefficient of linear thermal expansion equal to or less than  $5 \times 10^{-6}$  in any coordinate direction;
- d. Optical filters, as follows:
  1. For wavelengths longer than 250 nm, comprised of multi-layer optical coatings and having either of the following:
    - a. Bandwidths equal to or less than 1 nm Full Width Half Intensity (FWHI) and peak transmission of 90% or more; **or**
    - b. Bandwidths equal to or less than 0.1 nm FWHI and peak transmission of 50% or more;

**Note:**  
1061.4.d.1. does not embargo optical filters with fixed air gaps or Lyot-type filters.

  2. For wavelengths longer than 250 nm, having all of the following:
    - a. Tunable over a spectral range of 500 nm or more;
    - b. Instantaneous optical bandpass of 1.25 nm or less;
    - c. Wavelength resettable within 0.1 ms to an accuracy of 1 nm or better within the tunable spectral range; **and**
    - d. A single peak transmission of 91% or more;
  3. Optical opacity switches (filters) with a field of view of 30° or wider and a response time equal to or less than 1 ns;
- e. Optical control equipment, as follows:
  1. Specially designed to maintain the surface figure or orientation of the "space-qualified" components embargoed by 1061.4.c.1. or 3.;
  2. Having steering, tracking, stabilization or resonator alignment bandwidths equal to or more than 100 Hz and an accuracy of 10 microradians or less;
  3. Gimbals having a maximum slew exceeding 5°, a bandwidth equal to or more than 100 Hz, and either of the following:
    - a. 1. Exceeding 0.15 m but not exceeding 1 m in diameter or major axis length;
    2. Capable of angular accelerations exceeding 2 radians/s<sup>2</sup>; **and**
    3. Having angular pointing errors equal to or less than 200 microradians; or
    - b. 1. Exceeding 1 m in diameter or major axis length;
    2. Capable of angular accelerations exceeding 0.5 radian/s<sup>2</sup>; **and**
    3. Having angular pointing errors equal to or less than 200 microradians;
  4. Specially designed to maintain the alignment of phased array or phased segment mirror systems consisting of mirrors with a segment diameter or major axis length of 1 m or more;
- f. "Fluoride fibre" cable, or optical fibres therefor, having an attenuation of less than 4 dB/km in the wavelength range exceeding 1,000 nm but not exceeding 3,000 nm;

5. Lasers

"Lasers", components and optical equipment, as follows:

**Notes:**

1. Pulsed "lasers" include those that run in a continuous wave (CW) mode with pulses superimposed.
2. Pulse-excited "lasers" include those that run in a continuously excited mode with pulse excitation superimposed.

3. The embargo status of Raman "lasers" is determined by the parameters of the pumping source "lasers". The pumping source "lasers" can be any of the "lasers" described below.
5. a. Gas "lasers", as follows:
  1. Excimer "lasers" having any of the following:
    - a. An output wavelength not exceeding 150 nm **and**:
      1. An output energy exceeding 50 mJ per pulse; **or**
      2. An average or CW output power exceeding 1 W;
    - b. An output wavelength exceeding 150 nm but not exceeding 190 nm **and**:
      1. An output energy exceeding 1.5 J per pulse; **or**
      2. An average or CW output power exceeding 120 W;
    - c. An output wavelength exceeding 190 nm but not exceeding 360 nm **and**:
      1. An output energy exceeding 10 J per pulse; **or**
      2. An average or CW output power exceeding 500 W; **or**
    - d. An output wavelength exceeding 360 nm **and**:
      1. An output energy exceeding 1.5 J per pulse; **or**
      2. An average or CW output power exceeding 30 W;
  2. Metal vapour "lasers", as follows:
    - a. Copper (Cu) "lasers" with an average or CW output power exceeding 20 W;
    - b. Gold (Au) "lasers" with an average or CW output power exceeding 5 W;
    - c. Sodium (Na) "lasers" with an output power exceeding 5 W;
    - d. Barium (Ba) "lasers" with an average or CW output power exceeding 2 W;
  3. Carbon monoxide (CO) "lasers" having either:
    - a. An output energy exceeding 2 J per pulse and a pulsed "peak power" exceeding 5 kW; **or**
    - b. An average or CW output power exceeding 5 kW;
  4. Carbon dioxide (CO<sub>2</sub>) "lasers" having any of the following:
    - a. A CW output power exceeding 10 kW;
    - b. A pulsed output with a "pulse duration" exceeding 10 µs **and**:
      1. An average output power exceeding 10 kW; **or**
      2. A pulsed "peak power" exceeding 100 kW; **or**
    - c. A pulsed output with a "pulse duration" equal to or less than 10 µs **and**:
      1. A pulse energy exceeding 5 J per pulse and "peak power" exceeding 2.5 kW; **or**
      2. An average output power exceeding 2.5 kW;
  5. "Chemical lasers", as follows:
    - a. Hydrogen Fluoride (HF) "lasers";
    - b. Deuterium Fluoride (DF) "lasers";
    - c. "Transfer lasers":
      1. Oxygen Iodine (O<sub>2</sub>-I) "lasers";
      2. Deuterium Fluoride-Carbon dioxide (DF-CO<sub>2</sub>) "lasers";
  6. Gas discharge and ion "lasers", i.e. krypton ion or argon ion "lasers", having either:
    - a. An output energy exceeding 1.5 J per pulse and a pulsed "peak power" exceeding 50 W; **or**
    - b. An average or CW output power exceeding 50 W;
  7. Other gas "lasers", except nitrogen "lasers", having any of the following:
    - a. An output wavelength not exceeding 150 nm **and**:
      1. An output energy exceeding 50 mJ per pulse and a pulsed "peak power" exceeding 1 W; **or**
      2. An average or CW output power exceeding 1 W;
    - b. An output wavelength exceeding 150 nm but not exceeding 800 nm **and**:
      1. An output energy exceeding 1.5 J per pulse and a pulsed "peak power" exceeding 30 W; **or**
      2. An average or CW output power exceeding 30 W;
    - c. An output wavelength exceeding 800 nm but not exceeding 1,400 nm **and**:
      1. An output energy exceeding 0.25 J per pulse and a pulsed "peak power" exceeding 10 W; **or**
      2. An average or CW output power exceeding 10 W; **or**
    - d. An output wavelength exceeding 1,400 nm and an average or CW output power exceeding 1 W;

1061. cont'd.

5. b. Semiconductor "lasers", as follows:

**Technical Note:**

Semiconductor "lasers" are commonly called "laser" diodes.

**Note:**

The embargo status of semiconductor "lasers" specially designed for other equipment is determined by the embargo status of the other equipment.

1. Individual, single-transverse mode semiconductor "lasers" having:
  - a. An average output power exceeding 100 mW; **or**
  - b. A wavelength exceeding 1,050 nm;
2. Individual, multiple-transverse mode semiconductor "lasers", or arrays of individual semiconductor "lasers", having:
  - a. An output energy exceeding 500 µJ per pulse and a pulsed "peak power" exceeding 10 W;
  - b. An average or CW output power exceeding 10 W; **or**
  - c. A wavelength exceeding 1,050 nm;

c. Solid state "lasers", as follows:

1. "Tunable" "lasers" having any of the following:

**Note:**

1061.5.c.1. includes titanium - sapphire (Ti: Al<sub>2</sub>O<sub>3</sub>), thulium - YAG (Tm: YAG), thulium - YSGG (Tm: YSGG), alexandrite (Cr: BeAl<sub>2</sub>O<sub>4</sub>) and colour centre "lasers".

- a. An output wavelength less than 600 nm **and**:
  1. An output energy exceeding 50 mJ per pulse and a pulsed "peak power" exceeding 1 W; **or**
  2. An average or CW output power exceeding 1 W;
- b. An output wavelength of 600 nm or more but not exceeding 1,400 nm **and**:
  1. An output energy exceeding 1 J per pulse and a pulsed "peak power" exceeding 20 W; **or**
  2. An average or CW output power exceeding 20 W; **or**
- c. An output wavelength exceeding 1,400 nm **and**:
  1. An output energy exceeding 50 mJ per pulse and a pulsed "peak power" exceeding 1 W; **or**
  2. An average or CW output power exceeding 1 W;

2. Non-"tunable" "lasers", as follows:

**Note:**

1061.5.c.2. includes atomic transition solid state "lasers".

- a. Ruby "lasers" having an output energy exceeding 20 J per pulse;
- b. Neodymium glass "lasers", as follows:

1. "Q-switched lasers" having:

- a. An output energy exceeding 20 J but not exceeding 50 J per pulse and an average output power exceeding 10 W; **or**
- b. An output energy exceeding 50 J per pulse;

2. Non-"Q-switched lasers" having:

- a. An output energy exceeding 50 J but not exceeding 100 J per pulse and an average output power exceeding 20 W; **or**
- b. An output energy exceeding 100 J per pulse;

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

(For neodymium-doped (other than glass) "lasers" having an output wavelength not exceeding 1,000 nm or exceeding 1,100 nm, see 1061.5.c.2.d.)

1. Pulse-excited, mode-locked, "Q-switched lasers" with a "pulse duration" of less than 1 ns **and**:

- a. A "peak power" exceeding 5 GW;
- b. An average output power exceeding 10 W; **or**
- c. A pulsed energy exceeding 0.1 J;

2. Pulse-excited, "Q-switched lasers" with a pulse duration equal to or more than 1 ns, **and**:

- a. A single-transverse mode output with:
  1. A "peak power" exceeding 100 MW;
  2. An average output power exceeding 20 W; **or**
  3. A pulsed energy exceeding 2 J; **or**
- b. A multiple-transverse mode output with:
  1. A "peak power" exceeding 200 MW;

2. An average output power exceeding 50 W; **or**
3. A pulsed energy exceeding 2 J;

3. Pulse-excited, non-"Q-switched lasers", having:

- a. A single-transverse mode output with:
  1. A "peak power" exceeding 500 kW; **or**
  2. An average output power exceeding 150 W; **or**
- b. A multiple-transverse mode output with:
  1. A "peak power" exceeding 1 MW; **or**
  2. An average power exceeding 500 W;

4. Continuously excited "lasers" having:

- a. A single-transverse mode output with:
  1. A "peak power" exceeding 500 kW; **or**
  2. An average or CW output power exceeding 150 W; **or**
- b. A multiple-transverse mode output with:
  1. A "peak power" exceeding 1 MW; **or**
  2. An average or CW output power exceeding 500 W;

d. Other non-"tunable" "lasers", having any of the following:

1. A wavelength less than 150 nm **and**:
  - a. An output energy exceeding 50 mJ per pulse and a pulsed "peak power" exceeding 1 W; **or**
  - b. An average or CW output power exceeding 1 W;
2. A wavelength of 150 nm or more but not exceeding 800 nm **and**:
  - a. An output energy exceeding 1.5 J per pulse and a pulsed "peak power" exceeding 30 W; **or**
  - b. An average or CW output power exceeding 30 W;
3. A wavelength exceeding 800 nm but not exceeding 1,400 nm, as follows:
  - a. "Q-switched lasers" with:
    1. An output energy exceeding 0.5 J per pulse and a pulsed "peak power" exceeding 50 W; **or**
    2. An average output power exceeding:
      - a. 10 W for single-mode "lasers";
      - b. 30 W for multimode "lasers";
  - b. Non-"Q-switched lasers" with:
    1. An output energy exceeding 2 J per pulse and a pulsed "peak power" exceeding 50 W; **or**
    2. An average or CW output power exceeding 50 W; **or**
4. A wavelength exceeding 1,400 nm **and**:
  - a. An output energy exceeding 100 mJ per pulse and a pulsed "peak power" exceeding 1 W; **or**
  - b. An average or CW output power exceeding 1 W;

d. Dye and other liquid "lasers", having any of the following:

1. A wavelength less than 150 nm **and**:
  - a. An output energy exceeding 50 mJ per pulse and a pulsed "peak power" exceeding 1 W; **or**
  - b. An average or CW output power exceeding 1 W;
2. A wavelength of 150 nm or more but not exceeding 800 nm **and**:
  - a. An output energy exceeding 1.5 J per pulse and a pulsed "peak power" exceeding 20 W;
  - b. An average or CW output power exceeding 20 W; **or**
  - c. A pulsed single longitudinal mode oscillator with an average output power exceeding 1 W and a repetition rate exceeding 1 kHz if the "pulse duration" is less than 100 ns;
3. A wavelength exceeding 800 nm but not exceeding 1,400 nm **and**:
  - a. An output energy exceeding 0.5 J per pulse and a pulsed "peak power" exceeding 10 W; **or**
  - b. An average or CW output power exceeding 10 W; **or**
4. A wavelength exceeding 1,400 nm **and**:
  - a. An output energy exceeding 100 mJ per pulse and a pulsed "peak power" exceeding 1 W; **or**
  - b. An average or CW output power exceeding 1 W;

e. Free electron "lasers";

f. Components, as follows:

1. Mirrors cooled either by active cooling or by heat pipe cooling;

**Technical Note:**

*Active cooling is a cooling technique for optical components using flowing fluids within the subsurface (nominally less than 1 mm below the optical surface) of the optical component to remove heat from the optic.*

5. f. 2. Optical mirrors or transmissive or partially transmissive optical or electro-optical components specially designed for use with embargoed "lasers";
- g. Optical equipment, as follows:  
(For shared aperture optical elements, capable of operating in "Super-High Power Laser" ("SHPL") applications, see Item 2023.d. on the Munitions List.)
  1. Dynamic wavefront (phase) measuring equipment capable of mapping at least 50 positions on a beam wavefront with:
    - a. Frame rates equal to or more than 100 Hz and phase discrimination of at least 5% of the beam's wavelength; or
    - b. Frame rates equal to or more than 1,000 Hz and phase discrimination of at least 20% of the beam's wavelength;
  2. "Laser" diagnostic equipment capable of measuring "SHPL" system angular beam steering errors of equal to or less than 10 microradians;
  3. Optical equipment, assemblies or components specially designed for a phased-array "SHPL" system for coherent beam combination to an accuracy of  $\lambda/10$  at the designed wavelength, or 0.1  $\mu\text{m}$ , whichever is the smaller;
  4. Projection telescopes specially designed for use with "SHPL" systems;

**6. Magnetometers**

"Magnetometers", "magnetic gradiometers", "intrinsic magnetic gradiometers" and compensation systems, and specially designed components therefor, as follows:

**Note:**

1061.6 does not embargo instruments specially designed for biomagnetic measurements for medical diagnostics, unless they incorporate unembedded sensors embargoed by 1061.6.h.

- a. "Magnetometers" using "superconductive", optically pumped or nuclear precession (proton/Overhauser) technology having a "noise level" (sensitivity) lower (better) than 0.05 nT rms per square root Hz;
- b. Induction coil "magnetometers" having a "noise level" (sensitivity) lower (better) than:
  1. 0.05 nT rms per square root Hz at frequencies of less than 1 Hz;
  2.  $1 \times 10^{-3}$  nT rms per square root Hz at frequencies of 1 Hz or more but not exceeding 10 Hz; or
  3.  $1 \times 10^{-4}$  nT rms per square root Hz at frequencies exceeding 10 Hz;
- c. Fibre optic "magnetometers" having a "noise level" (sensitivity) lower (better) than 1 nT rms per square root Hz;
- d. "Magnetic gradiometers" using multiple "magnetometers" embargoed by 1061.6.a., b. or c.;
- e. Fibre optic "intrinsic magnetic gradiometers" having a magnetic gradient field "noise level" (sensitivity) lower (better) than 0.3 nT/m rms per square root Hz;
- f. "Intrinsic magnetic gradiometers", using technology other than fibre-optic technology, having a magnetic gradient field "noise level" (sensitivity) lower (better) than 0.015 nT/m rms per square root Hz;
- g. Magnetic compensation systems for magnetic sensors designed for operation on mobile platforms;
- h. "Superconductive" electromagnetic sensors, containing components manufactured from "superconductive" materials:
  1. Designed for operation at temperatures below the "critical temperature" of at least one of their "superconductive" constituents (including Josephson effect devices or "superconductive" quantum interference devices (SQUIDS));
  2. Designed for sensing electromagnetic field variations at frequencies of 1 kHz or less; and
  3. Having any of the following characteristics:
    - a. Incorporating thin-film SQUIDS with a minimum feature size of less than 2  $\mu\text{m}$  and with associated input and output coupling circuits;
    - b. Designed to operate with a magnetic field slew rate exceeding  $1 \times 10^6$  magnetic flux quanta per second;
    - c. Designed to function without magnetic shielding in the earth's ambient magnetic field; or

- d. Having a temperature coefficient less (smaller) than 0.1 magnetic flux quantum/K;

**7. Gravimeters**

Gravity meters (gravimeters) and gravity gradiometers, as follows:

- a. Gravity meters for ground use having a static accuracy of less (better) than 10 microgal;

**Note:**

1061.7.a. does not embargo ground gravity meters of the quartz element (Worden) type.

- b. Gravity meters for mobile platforms for ground, marine, submersible, space or airborne use having:
  1. A static accuracy of less (better) than 0.7 milligal; and
  2. An in-service (operational) accuracy of less (better) than 0.7 milligal with a time-to-steady-state registration of less than 2 minutes under any combination of attendant corrective compensations and motional influences;
- c. Gravity gradiometers;

**8. Radar**

Radar systems, equipment and assemblies having any of the following characteristics, and specially designed components therefor:

**Note:**

1061.8. does not embargo:

- a. Secondary surveillance radar (SSR);
- b. Car radar designed for collision prevention;
- c. Displays or monitors used for air traffic control (ATC) having no more than 12 resolvable elements per mm;
- d. Meteorological (weather) radar.
8. a. Operating at frequencies from 40 GHz to 230 GHz and having an average output power exceeding 100 mW;
- b. Having a tunable bandwidth exceeding  $\pm 6.25\%$  of the centre operating frequency;

**Technical Note:**

*The centre operating frequency equals one half of the sum of the highest plus the lowest specified operating frequencies;*

- c. Capable of operating simultaneously on more than two carrier frequencies;
- d. Capable of operating in synthetic aperture (SAR), inverse synthetic aperture (ISAR) or sidelooking airborne (SLAR) radar mode;
- e. Incorporating "electronically steerable phased array antennae";
- f. Capable of heightfinding non-cooperative targets;

**Note:**

1061.8.f. does not embargo precision approach radar equipment (PAR) conforming to ICAO standards.

- g. Designed specially for airborne (balloon or airframe mounted) operation and having Doppler signal processing for the detection of moving targets;
- h. Employing processing of radar signals using:
  1. "Radar spread spectrum" techniques; or
  2. "Radar frequency agility" techniques;
- i. Providing ground-based operation with a maximum "instrumented range" exceeding 185 km;

**Note:**

1061.8.i. does not embargo:

- a. Fishing ground surveillance radar;
- b. Ground radar equipment specially designed for enroute air traffic control and "software" specially designed for the "use" thereof, provided:
  1. It has a maximum "instrumented range" of 500 km or less;
  2. It is configured so that radar target data can be transmitted only one way from the radar site to one or more civil ATC centres;
  3. It contains no provisions for remote control of the radar scan rate from the enroute ATC centre; and
  4. It is to be permanently installed.

**N.B.:**

*The "use" "software" must be limited to "object code" and the minimum amount of "source code" necessary for installation, operation or maintenance.*

#### 1061. cont'd.

8. j. "Laser" radar or Light Detection and Ranging (LIDAR) equipment, having either of the following:
1. "Space-qualified"; or
  2. Employing coherent heterodyne or homodyne detection techniques and having an angular resolution of less (better) than 20 microradians;

#### Note:

1061.8.j. does not embargo LIDAR equipment specially designed for surveying or for meteorological observation.

- k. Having signal processing sub-systems using "pulse compression" with:
1. A "pulse compression" ratio exceeding 150; or
  2. A pulse width of less than 200 ns; or
- l. Having data processing sub-systems with:
1. "Automatic target tracking" providing, at any antenna rotation, the predicted target position beyond the time of the next antenna beam passage;

#### Note:

1061.8.l.1. does not embargo conflict alert capability in ATC systems, or marine or harbour radar.

2. Calculation of target velocity from primary radar having non-periodic (variable) scanning rates;
3. Processing for automatic pattern recognition (feature extraction) and comparison with target characteristic data bases (waveforms or imagery) to identify or classify targets; or
4. Superposition and correlation, or fusion, of target data from two or more "geographically dispersed" and "interconnected radar sensors" to enhance and discriminate targets.

#### Note:

1061.8.l.4. does not embargo systems, equipment and assemblies used for marine traffic control.

### 1062. Test, Inspection and Production Equipment

1. Acoustics – None
2. Optical Sensors – None
3. Cameras – None
4. Optics

- a. Equipment for measuring absolute reflectance to an accuracy of  $\pm 0.1\%$  of the reflectance value;
- b. Equipment other than optical surface scattering measurement equipment, having an unobscured aperture of more than 10 cm, specially designed for the non-contact optical measurement of a non-planar optical surface figure (profile) to an "accuracy" of 2 nm or less (better) against the required profile.

#### Note:

1062.4. does not embargo microscopes.

#### 5. Lasers

Specially designed or modified equipment, including tools, dies, fixtures or gauges, as follows, and other specially designed components and accessories therefor:

- a. For the manufacture or inspection of:
  1. Free electron "laser" magnet wigglers;
  2. Free electron "laser" photo injectors;
- b. For the adjustment, to required tolerances, of the longitudinal magnetic field of free electron "lasers".

#### 6. Magnetometers – None

#### 7. Gravimeters

Equipment to produce, align and calibrate land-based gravity meters with a static accuracy of better than 0.1 milligal;

#### 8. Radar

Pulse radar cross-section measurement systems having transmit pulse widths of 100 ns or less and specially designed components therefor.

### 1063. Materials

1. Acoustics • None
2. Optical Sensors

- a. Elemental tellurium (Te) of purity levels equal to or more than 99.9995%;

- b. Single crystals of cadmium telluride (CdTe), cadmium zinc telluride (CdZnTe) or mercury cadmium telluride (HgCdTe) of any purity level, including epitaxial wafers thereof;
- c. "Optical fibre preforms" specially designed for the manufacture of high birefringence fibres embargoed by 1061.2.d.3;

#### 3. Cameras – None

#### 4. Optics

- a. Zinc selenide (ZnSe) and zinc sulphide (ZnS) "substrate blanks" produced by the chemical vapour deposition process:
  1. Larger than 100 cm<sup>3</sup> in volume; or
  2. Larger than 80 mm in diameter with a thickness equal to or more than 20 mm;
- b. Boules of the following electro-optic materials:
  1. Potassium titanyl arsenate (KTA);
  2. Silver gallium selenide (AgGaSe<sub>2</sub>);
  3. Thallium arsenic selenide (Tl<sub>3</sub>AsSe<sub>3</sub>, also known as TAS);
- c. Non-linear optical materials having:
  1. Third order susceptibility ( $\chi^3$ ) equal to or less than 1 W/m<sup>2</sup>; and
  2. A response time of less than 1 ms;
- d. "Substrate blanks" of silicon carbide or beryllium beryllium (Be/Be) deposited materials exceeding 300 mm in diameter or major axis length;
- e. Low optical absorption materials, as follows:
  1. Bulk fluoride compounds containing ingredients with a purity of 99.999% or better;

#### Note:

1063.4.e.1. embargoes fluorides of zirconium or aluminium and variants.

2. Bulk fluoride glass made from compounds embargoed by 1063.4.e.1.;
- f. Glass, including fused silica, phosphate glass, fluorophosphate glass, zirconium fluoride (ZrF<sub>4</sub>) and hafnium fluoride (HfF<sub>4</sub>), with:
  1. A hydroxyl ion (OH<sup>-</sup>) concentration of less than 5 ppm;
  2. Integrated metallic purity levels of less than 1 ppm; and
  3. High homogeneity (index of refraction variance) less than  $5 \times 10^{-6}$ ;
- g. Synthetically produced diamond material with an absorption of less than 10<sup>-5</sup> cm<sup>-1</sup> for wavelengths exceeding 200 nm but not exceeding 14,000 nm;
- h. "Optical fibre preforms" made from bulk fluoride compounds containing ingredients with a purity of 99.999% or better, specially designed for the manufacture of "fluoride fibres" embargoed by 1061.4.f.;

#### 5. Lasers

Synthetic crystalline "laser" host material in unfinished form, as follows:

- a. Titanium doped sapphire;
- b. Alexandrite;

#### 6. Magnetometers – None

#### 7. Gravimeters – None

#### 8. Radar - None

### 1064. Software

1. "Software" specially designed for the "development" or "production" of equipment embargoed by 1061.4, 1061.5, 1061.8 or 1062.8.;
2. "Software" specially designed for the "use" of equipment embargoed by 1061.2.b., 1061.8 or 1062.8.;
3. Other "software", as follows:
  - a. Acoustics
    1. "Software" specially designed for acoustic beam forming for the "real time processing" of acoustic data for passive reception using towed hydrophone arrays;
    2. "Source code" for the "real time processing" of acoustic data for passive reception using towed hydrophone arrays;
  - b. Optical Sensors – None
  - c. Cameras – None
  - d. Optics – None
  - e. Lasers – None
  - f. Magnetometers
    1. "Software" specially designed for magnetic compensation systems for magnetic sensors designed to operate on mobile platforms;
    2. "Software" specially designed for magnetic anomaly detection on mobile platforms;

#### 1064. cont'd.

- g. Gravimeters  
"Software" specially designed to correct motional influences of gravity meters or gravity gradiometers;
- h. Radar
  1. Air Traffic Control "software" application "programmes" hosted on general purpose computers located at Air Traffic Control centres and capable of any of the following:
    - a. Processing and displaying more than 150 simultaneous "system tracks";
    - b. Accepting radar target data from more than four primary radars;  
**or**
    - c. Automatically handing over primary radar target data (if not correlated with secondary surveillance radar (SSR) data) from the host ATC centre to another ATC centre;
  2. "Software" for the design or "production" of radomes which:
    - a. Are specially designed to protect the "electronically steerable phased array antennae" embargoed by 1061.8.e.; **and**
    - b. Limit the average side-lobe level increase by less than 13 dB for frequencies equal to or higher than 2 GHz.

#### 1065. Technology

1. Technology according to the General Technology Note for the "development" of equipment, materials or "software" embargoed by 1061., 1062., 1063. or 1064.;
2. Technology according to the General Technology Note for the "production" of equipment or materials embargoed by 1061., 1062. or 1063.;
3. Other technology:
  - a. Acoustics – None
  - b. Optical Sensors – None
  - c. Cameras – None
  - d. Optics
    1. Optical surface coating and treatment technology required to achieve uniformity of 99.5% or better for optical coatings 500 mm or more in diameter or major axis length and with a total loss (absorption and scatter) of less than  $5 \times 10^{-3}$ ;
    2. Optical fabrication technologies, as follows:
      - a. For serially producing optical components at a rate exceeding 10 m<sup>2</sup> of surface area per year on any single spindle and with:
        1. An area exceeding 1 m<sup>2</sup>; **and**
        2. A surface figure exceeding  $\lambda/10$  rms at the designed wavelength;
      - b. Single point diamond turning techniques producing surface finish accuracies of better than 10 nm rms on non-planar surfaces exceeding 0.5 m<sup>2</sup>;  
(See also 1025.3.d.)
  - e. Lasers
    1. Technology for optical filters with a bandwidth equal to or less than 10 nm, a field of view (FOV) exceeding 40° and a resolution exceeding 0.75 line pairs per milliradian;
    2. "Technology" "required" for the "development", "production" or "use" of specially designed diagnostic instruments or targets in test facilities for "SHPL" testing or testing or evaluation of materials irradiated by "SHPL" beams;
  - f. Magnetometers  
Technology "required" for the "development" or "production" of fluxgate "magnetometers" or fluxgate "magnetometer" systems having a noise level:
    1. Less than 0.05 nT rms per square root Hz at frequencies of less than 1 Hz; **or**
    2.  $1 \times 10^{-3}$  nT rms per square root Hz at frequencies of 1 Hz or more;
  - g. Gravimeters – None
  - h. Radar – None

## 1070. Navigation and Avionics

### 1071. Equipment, Assemblies and Components

1. Accelerometers designed for use in inertial navigation or guidance systems and having any of the following characteristics, and specially designed components therefor:
  - a. A "bias" "stability" of less (better) than 130 micro g with respect to a fixed calibration value over a period of one year;
  - b. A "scale factor" "stability" of less (better) than 130 ppm with respect to a fixed calibration value over a period of one year;
  - c. Specified to function at linear acceleration levels exceeding 100 g;
2. Gyros having any of the following characteristics, and specially designed components therefor:
  - a. A "drift rate" "stability", when measured in a 1 g environment over a period of three months and with respect to a fixed calibration value, of:
    1. Less (better) than 0.1° per hour when specified to function at linear acceleration levels below 10 g; **or**
    2. Less (better) than 0.5° per hour when specified to function at linear acceleration levels from 10 to 100 g inclusive;
  - b. Specified to function at linear acceleration levels above 100 g;
3. Inertial navigation systems (gimballed and strapdown) and inertial equipment for attitude, guidance or control having any of the following characteristics, and specially designed components therefor:
  - a. For "aircraft":
    1. Navigation error (free inertial) of 0.8 nautical mile per hour (50% Circular Error Probable (CEP)) or less (better) subsequent to normal alignment;
    2. Not certified for use on "civil aircraft" by civil aviation authorities of a member country; **or**
    3. Specified to function at linear acceleration levels exceeding 10 g;
  - b. For land or "spacecraft":
    1. Navigation error (free inertial) of 0.8 nautical mile per hour (50% CEP) or less (better) subsequent to normal alignment; **or**
    2. Specified to function at linear acceleration levels exceeding 10 g;
4. Gyro-astro compasses, and other devices which derive position or orientation by means of automatically tracking celestial bodies or satellites, with an azimuth accuracy of equal to or less (better) than 5 seconds of arc;
5. Global Positioning Satellite (GPS) receiving equipment having either of the following characteristics, and specially designed components therefor:
  - a. Employing encryption/decryption; **or**
  - b. A null-steerable antenna;
6. Airborne altimeters operating at frequencies other than 4.2 to 4.4 GHz inclusive, having either of the following characteristics:
  - a. "Power management"; **or**
  - b. Using phase shift key modulation.

#### Note:

(For automatic pilots for underwater vehicles, see Category 1080.

For radar, see Category 1060. For inertial navigation equipment for ships or submersibles, see Item 2009.e. on the Munitions List.)

### 1072. Test, Inspection and Production Equipment

1. Test, calibration or alignment equipment specially designed for equipment embargoed by 1071., except equipment for Maintenance Level I or Maintenance Level II;

#### Technical Notes:

1. Maintenance Level I

The failure of an inertial navigation unit is detected on the aircraft by indications from the control and display unit (CDU) or by the status message from the corresponding sub-system. By following the manufacturer's manual, the cause of the failure may be localised at the level of the malfunctioning line replaceable unit (LRU). The operator then removes the LRU and replaces it with a spare.

## 2. Maintenance Level II

The defective LRU is sent to the maintenance workshop (the manufacturer's or that of the operator responsible for level II maintenance). At the maintenance workshop, the malfunctioning LRU is tested by various appropriate means to verify and localise the defective shop replaceable assembly (SRA) module responsible for the failure. This SRA is removed and replaced by an operative spare. The defective SRA (or possibly the complete LRU) is then shipped to the manufacturer.

### **N.B.:**

Maintenance Level II does not include the removal of embargoed accelerometers or gyro sensors from the SRA.

2. Equipment, as follows, specially designed to characterize mirrors for ring "laser" gyros:
  - a. Scatterometers having a measurement accuracy of 10 ppm or less (better);
  - b. Profilometers having a measurement accuracy of 0.5 nm (5 angstrom) or less (better);
3. Equipment specially designed for the production of equipment embargoed by 1071., including:
  - a. Gyro tuning test stations;
  - b. Gyro dynamic balance stations;
  - c. Gyro run-in/motor test stations;
  - d. Gyro evacuation and fill stations;
  - e. Centrifuge fixtures for gyro bearings;
  - f. Accelerometer axis align stations.

## 1073. Materials

None

## 1074. Software

1. "Software" specially designed or modified for the "development" or "production" of equipment embargoed by 1071. or 1072.;
2. "Source code" for the "use" of any inertial navigation equipment or Attitude Heading Reference Systems (AHRS) (except gimballed AHRS) including inertial equipment not embargoed by 1071.3. or 1071.4.;

### **Technical Note:**

AHRS generally differ from inertial navigation systems (INS) in that an AHRS provides attitude heading information and normally does not provide the acceleration, velocity and position information associated with an INS.

3. Other "software", as follows:
  - a. "Software" specially designed or modified to improve the operational performance or reduce the navigational error of systems to the levels specified in 1071.3. or 1071.4.;
  - b. "Source code" for hybrid integrated systems which improves the operational performance or reduces the navigational error of systems to the level specified in 1071.3. by continuously combining inertial data with any of the following navigation data:
    1. Doppler radar velocity;
    2. Global Positioning Satellite (GPS) references; or
    3. terrain data base;
  - c. "Source code" for integrated avionics or mission systems which combine sensor data and employ knowledge-based expert systems;
  - d. "Source code" for the "development" of:
    1. Digital flight management systems for flight path optimization;
    2. Integrated propulsion and flight control systems;
    3. Fly-by-wire or fly-by-light control systems;
    4. Fault-tolerant or self-reconfiguring "active flight control systems";
    5. Airborne automatic direction finding equipment;
    6. Air data systems based on surface static data;
    7. Raster-type head-up displays or three dimensional displays.

## 1075. Technology

1. Technology according to the General Technology Note for the "development" of equipment or "software" embargoed by 1071., 1072. or 1074.;
2. Technology according to the General Technology Note for the "production" of equipment embargoed by 1071. or 1072.;

- 3 Technology according to the General Technology Note for the repair, refurbishing or overhaul of equipment embargoed by 1071.1. to 1071.4., except for maintenance technology directly associated with calibration, removal or replacement of damaged or unserviceable LRUs and SRAs of a "civil aircraft" as described in Maintenance Level I or Maintenance Level II. (see Technical Notes to 1072.1.)

### 4. Other technology, as follows:

- a. Technology for the "development" or "production" of:
  1. Airborne automatic direction finding equipment operating at frequencies exceeding 5 MHz;
  2. Air data systems based on surface static data only, i.e. which dispense with conventional air data probes;
  3. Raster-type head-up displays or three dimensional displays for "aircraft";
  4. Inertial navigation systems or gyro-astro compasses containing accelerometers or gyros embargoed by 1071.1. or 1071.2.;
- b. "Development" technology, as follows, for "active flight control systems" (including fly-by-wire or fly-by-light):
  1. Configuration design for interconnecting multiple microelectronic processing elements (on-board computers) to achieve "real time processing" for control law implementation;
  2. Control law compensation for sensor location or dynamic airframe loads, i.e. compensation for sensor vibration environment or for variation of sensor location from the centre of gravity;
  3. Electronic management of data redundancy or systems redundancy for fault detection, fault tolerance, fault isolation or reconfiguration;

### **Note:**

1075.4.b.3. does not embargo technology for the design of physical redundancy.

4. Flight controls which permit inflight reconfiguration of force and moment controls for real time autonomous air vehicle control;
5. Integration of digital flight control, navigation and propulsion control data into a digital flight management system for flight path optimization, except "development" technology for aircraft flight instrument systems integrated solely for VOR, DME, ILS or MLS navigation or approaches;
6. Full authority digital flight control or multi sensor mission management systems incorporating knowledge-based expert systems;  
(For technology for Full Authority Digital Engine Control (FADEC), see 1095.3.a.10.)
- c. Technology for the "development" of helicopter systems, as follows:
  1. Multi-axis fly-by-wire or fly-by-light controllers which combine the functions of at least two of the following into one controlling element:
    - a. Collective controls;
    - b. Cyclic controls;
    - c. Yaw controls;
  2. "Circulation-controlled anti-torque or circulation-controlled directional control systems";
  3. Rotor blades incorporating "variable geometry airfoils" for use in systems using individual blade control.

# 1080. Marine

## 1081. Equipment, Asemblies and Components

1. Submersible vehicles or surface vessels, as follows:

### Note:

For the embargo status of equipment for submersible vehicles, see: Category 1150 "Information Security" for encrypted communication equipment; Category 1060 for sensors; Categories 1070 and 1080 for navigation equipment; Category 1081. for underwater equipment.

1. a. Manned, tethered submersible vehicles designed to operate at depths exceeding 1,000 m;
- b. Manned, untethered submersible vehicles:
  1. Designed to operate autonomously and having a lifting capacity of:
    - a. 10% or more of their weight in air; **and**
    - b. 15 kN or more;
  2. Designed to operate at depths exceeding 1,000 m; **or**
  3. a. Designed to carry a crew of 4 or more;
  - b. Designed to operate autonomously for 10 hours or more;
  - c. Having a range of 25 nautical miles or more; **and**
  - d. Having a length of 21 m or less;

### Technical Notes:

1. 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.
  2. Range: half the maximum distance a submersible vehicle can cover.
1. c. Unmanned, tethered submersible vehicles designed to operate at depths exceeding 1,000 m:
    1. Designed for self-propelled manoeuvre using propulsion motors or thrusters embargoed by 1081.2.a.2.; **or**
    2. Having a fibre optic data link;
  - d. Unmanned, untethered submersible vehicles:
    1. Designed for deciding a course relative to any geographical reference without real-time human assistance;
    2. Having an acoustic data or command link; **or**
    3. Having a fibre optic data or command link exceeding 1,000 m;
  - e. Ocean salvage systems with a lifting capacity exceeding 5 MN for salvaging objects from depths exceeding 250 m and having either of the following:
    1. Dynamic positioning systems capable of position keeping within 20 m of a given point provided by the navigation system; **or**
    2. Seafloor navigation and navigation integration systems for depths exceeding 1,000 m with positioning accuracies to within 10 m of a predetermined point;
  - f. Surface-effect vehicles (fully skirted variety) with a maximum design speed, fully loaded, exceeding 30 knots in a significant wave height of 1.25 m (Sea State 3) or more, a cushion pressure exceeding 3,830 Pa, and a light-ship-to-full-load displacement ratio of less than 0.70;
  - g. Surface-effect vehicles (rigid sidewalls) with a maximum design speed, fully loaded, exceeding 40 knots in a significant wave height of 3.25 m (Sea State 5) or more;
  - h. Hydrofoil vessels with active systems for automatically controlling foil systems, with a maximum design speed, fully loaded, of 40 knots or more in a significant wave height of 3.25 m (Sea State 5) or more;
  - i. Small waterplane area vessels with:
    1. A full load displacement exceeding 500 tonnes with a maximum design speed, fully loaded, exceeding 35 knots in a significant wave height of 3.25 m (Sea State 5) or more; **or**
    2. A full load displacement exceeding 1,500 tonnes with a maximum design speed, fully loaded, exceeding 25 knots in a significant wave height of 4 m (Sea State 6) or more;

### Technical Note:

A small waterplane area vessel is defined by the following formula: waterplane area at an operational design draft less than  $2 \times (\text{displaced volume at the operational design draft})^{2/3}$ .

2. Systems or equipment, as follows:

- a. Systems or equipment, specially designed or modified for submersible vehicles, designed to operate at depths exceeding 1,000 m, as follows:
  1. Pressure housings or pressure hulls with a maximum inside chamber diameter exceeding 1.5 m;
  2. Direct current propulsion motors or thrusters;
  3. Umbilical cables, and connectors therefor, using optical fibre and having synthetic strength members;
- b. Systems specially designed or modified for the automated control of the motion of equipment for submersible vehicles embargoed by 1081.1. using navigation data and having closed loop servo-controls to:
  1. Enable a 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 seabed;
- c. Fibre optic hull penetrators or connectors;
- d. Underwater vision systems, as follows:
  1. a. Television systems (comprising camera, lights, monitoring and signal transmission equipment) having a limiting resolution when measured in air of more than 500 lines and specially designed or modified for remote operation with a submersible vehicle; **or**
  - b. Underwater television cameras having a limiting resolution when measured in air of more than 700 lines;

### 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, using IEEE Standard 208/1960 or any equivalent standard.

2. Systems, specially designed or modified for remote operation with an underwater vehicle, employing techniques to minimise the effects of back scatter, including range-gated illuminators or "laser" systems;
3. Low light level television cameras specially designed or modified for underwater use containing:
  - a. Image intensifier tubes embargoed by 1061.2.a.2.a.; **and**
  - b. More than 150,000 "active pixels" per solid state area array;
- e. Photographic still cameras specially designed or modified for underwater use, having a film format of 35 mm or larger, and:
  1. Annotating the film with data provided by a source external to the camera;
  2. Having autofocussing or remote focussing specially designed for underwater use;
  3. Having automatic back focal distance correction; **or**
  4. Having automatic compensation control specially designed to permit an underwater camera housing to be usable at depths exceeding 1,000 m;
- f. Electronic imaging systems, specially designed or modified for underwater use, capable of storing digitally more than 50 exposed images;
- g. Light systems, as follows, specially designed or modified for underwater use:
  1. Stroboscopic light systems capable of a light output energy of more than 300 J per flash;
  2. Argon arc light systems specially designed for use below 1,000 m;
- h. "Robots" specially designed for underwater use, controlled by using a dedicated stored programme computer:
  1. Having systems that control the "robot" using information from sensors which measure force or torque applied to an external object, distance to an external object, or tactile sense between the "robot" and an external object; **or**
  2. Capable of exerting a force of 250 N or more or a torque of 250 Nm or more and using titanium based alloys or "fibrous or filamentary" "composite" materials in their structural members;
- i. Remotely controlled articulated manipulators specially designed or modified for use with submersible vehicles:
  1. Having systems which control the manipulator using the information from sensors which measure the torque or force applied to an external object, or tactile sense between the manipulator and an external object; **or**

1081. cont'd.

2. i. 2. Controlled by proportional master-slave techniques or by using a dedicated stored programme computer, and having 5 degrees of freedom of movement or more;

**Note:**

*Only functions having proportional control using positional feedback or by using a dedicated stored programme computer are counted when determining the number of degrees of freedom of movement.*

- j. Air independent power systems, as follows, specially designed for underwater use:
1. Brayton, Stirling or Rankine cycle engine air independent power systems having any of the following:
    - a. Chemical scrubber or absorber systems specially designed to remove carbon dioxide, carbon monoxide and particulates from recirculated engine exhaust;
    - b. Systems specially designed to use a monoatomic gas;
    - c. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10 kHz, or special mounting devices for shock mitigation; **or**
    - d. Systems specially designed:
      1. To pressurise the products of reaction or for fuel reformation;
      2. To store the products of the reaction; **and**
      3. To discharge the products of the reaction against a pressure of 100 kPa or more;
  2. Diesel cycle engine air independent systems, having all of the following:
    - a. Chemical scrubber or absorber systems specially designed to remove carbon dioxide, carbon monoxide and particulates from recirculated engine exhaust;
    - b. Systems specially designed to use a monoatomic gas;
    - c. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10 kHz or special mounting devices for shock mitigation; **and**
    - d. Specially designed exhaust systems that do not exhaust continuously the products of combustion;
  3. Fuel cell air independent power systems with an output exceeding 2 kW having either of the following:
    - a. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10 kHz or special mounting devices for shock mitigation; **or**
    - b. Systems specially designed:
      1. To pressurise the products of reaction or for fuel reformation;
      2. To store the products of the reaction; **and**
      3. To discharge the products of the reaction against a pressure of 100 kPa or more;
- k. Skirts, seals and fingers, as follows:
1. Designed for cushion pressures of 3,830 Pa or more, operating in a significant wave height of 1.25 m (Sea State 3) or more and specially designed for surface effect vehicles (fully skirted variety) embargoed by 1081.1.f.;
  2. Designed for cushion pressures of 6,224 Pa or more, operating in a significant wave height of 3.25 m (Sea State 5) or more and specially designed for surface effect vehicles (rigid sidewalls) embargoed by 1081.1.g.;
- l. Lift fans rated at more than 400 kW specially designed for surface effect vehicles embargoed by 1081.1.f. or 1081.1.g.;
- m. Fully submerged subcavitating or supercavitating hydrofoils specially designed for vessels embargoed by 1081.1.h.;
- n. Active systems specially designed or modified to control automatically the sea-induced motion of vehicles or vessels embargoed by 1081.1.f., g., h. or i.;
- o. 1. Water-screw propeller or power transmission systems, as follows, specially designed for surface effect vehicles (fully skirted or rigid sidewall variety), hydrofoils or small waterplane area vessels embargoed by 1081.1.f., g., h. or i.:
- a. Supercavitating, super-ventilated, partially-submerged or surface piercing propellers rated at more than 7.5 MW;
  - b. Contrarotating propeller systems rated at more than 15 MW;

- c. Systems employing pre-swirl or post-swirl techniques for smoothing the flow into a propeller;
  - d. Light-weight, high capacity (K factor exceeding 300) reduction gearing;
  - e. Power transmission shaft systems, incorporating "composite" material components, capable of transmitting more than 1 MW;
2. Water-screw propeller, power generation or transmission systems for use on vessels, as follows:
- a. Controllable-pitch propellers and hub assemblies rated at more than 30 MW;
  - b. Internally liquid-cooled electric propulsion engines with a power output exceeding 2.5 MW;
  - c. "Superconductive" propulsion engines, or permanent magnet electric propulsion engines, with a power output exceeding 0.1 MW;
  - d. Power transmission shaft systems, incorporating "composite" material components, capable of transmitting more than 2 MW;
  - e. Ventilated or base-ventilated propeller systems rated at more than 2.5 MW;
3. Noise reduction systems for use on vessels of 1,000 tonnes displacement or more, as follows:
- a. Noise reduction systems that attenuate at frequencies below 500 Hz and consist of compound acoustic mounts for the acoustic isolation of diesel engines, diesel generator sets, gas turbines, gas turbine generator sets, propulsion motors or propulsion reduction gears, specially designed for sound or vibration isolation, having an intermediate mass exceeding 30% of the equipment to be mounted;
  - b. Active noise reduction or cancellation systems, or magnetic bearings, specially designed for power transmission systems, and incorporating electronic control systems capable of actively reducing equipment vibration by the generation of anti-noise or anti-vibration signals directly to the source;
- p. Pumpjet propulsion systems with a power output exceeding 2.5 MW using divergent nozzle and flow conditioning vane techniques to improve propulsive efficiency or reduce propulsion-generated underwater-radiated noise.

*(For underwater communications systems, see Category 1050 - Telecommunications.)*

## 1082. Test, Inspection and Production Equipment

Water tunnels, having a background noise of less than 100 dB (reference 1 micropascal, 1 Hz) in the frequency range from 0 to 500 Hz, designed for measuring acoustic fields generated by a hydro-flow around propulsion system models.

## 1083. Materials

Syntactic foam for underwater use:

1. Designed for marine depths exceeding 1,000 m; **and**
2. With a density less than 561 kg/m<sup>3</sup>.

**Technical Note:**

*Syntactic foam consists of hollow spheres of plastic or glass embedded in a resin matrix.*

## 1084. Software

1. "Software" specially designed or modified for the "development", "production" or "use" of equipment or materials embargoed by 1081., 1082. or 1083.;
2. Specific "software" specially designed or modified for the "development", "production", repair, overhaul or refurbishing (re-machining) of propellers specially designed for underwater noise reduction.

## 1085. Technology

1. Technology according to the General Technology Note for the "development" or "production" of equipment or materials embargoed by 1081., 1082. or 1083.;
2. Other technology, as follows:
  - a. Technology for the "development", "production", repair, overhaul or refurbishing (re-machining) of propellers specially designed for underwater noise reduction;
  - b. Technology for the overhaul or refurbishing of equipment embargoed by 1081.1., 1081.2.b., j., o. or p.

# 1090. Propulsion

## 1091. Equipment, Assemblies and Components

(For propulsion systems designed or rated against neutron or transient ionizing radiation, see the Munitions List.)

1. Aero gas turbine engines incorporating any of the technologies embargoed by 1095.3.a., as follows:

- a. Not certified for the specific "civil aircraft" for which they are intended;

**Note:**

For the purpose of the "civil aircraft" certification process, a limited number of civil certified engines, assemblies or components may be exported as determined by Member Governments. This limited number is defined as the minimum required (up to 16, including spares) for civil certification.

- b. Not certified for civil use by the aviation authorities in a member country;
- c. Designed to cruise at speeds exceeding Mach 1.2 for more than thirty minutes;

2. Marine gas turbine engines with an ISO standard continuous power rating of 24.245 kW or more and a specific fuel consumption of less than 0.219 kg/kWh at any point in the power range from 35 to 100 %, and specially designed assemblies and components therefor;

**Note:**

The term 'marine gas turbine engines' includes those industrial, or aero-derivative, gas turbine engines adapted for marine propulsion or shipboard power generation.

3. Specially designed assemblies and components, incorporating any of the technologies embargoed by 1095.3.a., for the following gas turbine engine propulsion systems:

- a. Embargoed by 1091.1.; **or**
- b. Whose design or production origins are either proscribed countries or unknown to the manufacturer;

**Note:**

1091.3. does not embargo multiple domed combustors operating at average burner outlet temperatures equal to or less than 1,813 K (1,540 °C).

4. Space launch vehicles or "spacecraft" (not including their payloads); (For the embargo status of products contained in "spacecraft" payloads, see the appropriate Categories.)
5. Liquid rocket propulsion systems containing any of the systems or components embargoed by 1091.6.;
6. Systems or components, as follows, specially designed for liquid rocket propulsion systems:
  - a. Cryogenic refrigerators, flightweight dewars, cryogenic heat pipes or cryogenic systems specially designed for use in space vehicles and capable of restricting cryogenic fluid losses to less than 30% per year;
  - b. Cryogenic containers or closed-cycle refrigeration systems capable of providing temperatures of 100 K (-173°C) or less for "aircraft" capable of sustained flight at speeds exceeding Mach 3, launch vehicles or "spacecraft";
  - c. Slush hydrogen storage or transfer systems;
  - d. High pressure (exceeding 17.5 MPa) turbo pumps, pump components or their associated gas generator or expander cycle turbine drive systems;
  - e. High-pressure (exceeding 10.6 MPa) thrust chambers and nozzles therefor;
  - f. Propellant storage systems using the principle of capillary containment or positive expulsion (i.e. with flexible bladders);
7. Solid rocket propulsion systems with any of the following:
  - a. 1. Total impulse capacity exceeding 1.1 MNs; **or**
  2. Specific impulse of 2.4 kNs/kg or more when the nozzle flow is expanded to ambient sea level conditions for an adjusted chamber pressure of 7 MPa;
  - b. 1. Stage mass fractions exceeding 88%; **and**
  2. Propellant solid loadings exceeding 86%;
  - c. Any of the components embargoed by 1091.8.; **or**
  - d. Insulation and propellant bonding systems using direct-bonded motor designs to provide a strong mechanical bond or a barrier to chemical migration between the solid propellant and case insulation material;
8. Components, as follows, specially designed for solid rocket propulsion systems:
  - a. Insulation and propellant bonding systems using liners to provide a strong mechanical bond or a barrier to chemical migration between the solid propellant and case insulation material;

- b. Filament-wound "composite" motor cases exceeding 0.61 m in diameter or having structural efficiency ratios (PV/W) exceeding 25 km;

**Technical Note:**

The structural efficiency ratio (PV/W) is the burst pressure (P) multiplied by the vessel volume (V) divided by the total pressure vessel weight (W).

- c. Nozzles with thrust levels exceeding 45 kN or nozzle throat erosion rates of less than 0.075 mm/s;
- d. Movable nozzle or secondary fluid injection thrust vector control systems capable of:
  1. Omni-axial movement exceeding  $\pm 5^\circ$
  2. Angular vector rotations of  $20^\circ/s$  or more; **or**
  3. Angular vector accelerations of  $40^\circ/s^2$  or more;

**Technical Note:**

For the purposes of 1091.7.d. and 1091.8.a., a strong mechanical bond means bond strength equal to or more than propellant strength.

9. Hybrid rocket propulsion systems with:
  - a. Total impulse capacity exceeding 1.1 MNs; **or**
  - b. Thrust levels exceeding 220 kN in vacuum exit conditions;
10. Specially designed components or structures for launch vehicles or launch vehicle propulsion systems, manufactured using metal "matrix" "composite", organic "composite", ceramic "matrix" or intermetallic reinforced materials embargoed by 1013.7. or 1013.10.;
11. Ramjet, scramjet or combined cycle engines and specially designed components therefor.

## 1092. Test, Inspection and Production Equipment

1. Specially designed equipment, tooling or fixtures, as follows, for manufacturing or measuring gas turbine blades, vanes or tip shroud castings:
    - a. Automated equipment using non-mechanical methods for measuring airfoil wall thickness;
    - b. Tooling, fixtures or measuring equipment for the "laser", water jet or ECM/EDM hole drilling processes embargoed by 1095.3.c.;
    - c. Directional solidification or single crystal casting equipment;
    - d. Ceramic cores or shells;
    - e. Ceramic core manufacturing equipment or tools;
    - f. Ceramic core leaching equipment;
    - g. Ceramic shell wax pattern preparation equipment;
    - h. Ceramic shell burn out or firing equipment;
  2. On-line (real time) control systems, instrumentation (including sensors) or automated data acquisition and processing equipment, specially designed for the development of gas turbine engines, assemblies or components incorporating technologies embargoed by 1095.3.a.;
  3. Equipment specially designed for the production or test of gas turbine brush seals designed to operate at tip speeds exceeding 335 m/s, and specially designed parts or accessories therefor;
  4. Tools, dies or fixtures for the solid state joining of gas turbine "superalloy" or titanium components;
  5. On-line (real time) control systems, instrumentation (including sensors) or automated data acquisition and processing equipment, specially designed for use with the following wind tunnels or devices:
    - a. Wind tunnels designed for speeds of Mach 1.2 or more, except those specially designed for educational purposes and having a test section size (measured laterally) of less than 250 mm;
- Technical Note:**
- Test section size: the diameter of the circle, or the side of the square, or the longest side of the rectangle, at the largest test section location.
- b. Devices for simulating flow-environments at speeds exceeding Mach 5, including hot-shot tunnels, plasma arc tunnels, shock tubes, shock tunnels, gas tunnels and light gas guns;
  - c. Wind tunnels or devices, other than two-dimensional sections, capable of simulating Reynolds number flows exceeding  $25 \times 10^6$ ;
6. Specially designed acoustic vibration test equipment capable of producing sound pressure levels of 160 dB or more (referenced to 20 micropascals) with a rated output of 4 kW or more at a test cell temperature exceeding 1,273 K (1,000 °C), and specially designed transducers, strain gauges, accelerometers, thermocouples or quartz heaters therefor;
  7. Equipment specially designed for inspecting the integrity of rocket motors using non-destructive test (NDT) techniques other than planar X-ray or basic physical or chemical analysis;

### 1092. cont'd.

8. Transducers specially designed for the direct measurement of the wall skin friction of the test flow with a stagnation temperature exceeding 833 K (560°C);
9. Tooling specially designed for producing turbine engine powder metallurgy rotor components capable of operating at stress levels of 60% of ultimate tensile strength (UTS) or more and metal temperatures of 873 K (600°C) or more.

### 1093. Materials

None

### 1094. Software

1. "Software" required for the "development" of equipment or technology embargoed by 1091., 1092. or 1095.3.;
2. "Software" required for the "production" of equipment embargoed by 1091. or 1092.;
3. "Software" required for the "use" of full authority digital electronic engine controls (FADEC) for propulsion systems embargoed by 1091. or equipment embargoed by 1092., as follows:
  - a. "Software" in digital electronic controls for propulsion systems, aerospace test facilities or air breathing aero-engine test facilities;
  - b. Fault-tolerant "software" used in FADEC systems for propulsion systems and associated test facilities;
4. Other "software", as follows:
  - a. "Software" specially designed for vibration test equipment using real time digital controls with individual exciters (thrusters) with a maximum thrust exceeding 100 kN;
  - b. 2D or 3D viscous "software" validated with wind tunnel or flight test data required for detailed engine flow modelling;
  - c. "Software" required for the "development" or "production" of real time full authority electronic test facilities for engines or components embargoed by 1091.;
  - d. "Software" for testing aero gas turbine engines, assemblies or components, specially designed to collect, reduce and analyse data in real time, and capable of feedback control, including the dynamic adjustment of test articles or test conditions, as the test is in progress;
  - e. "Software" specially designed to control directional solidification or single crystal casting;
  - f. "Software" in "source code", "object code" or machine code required for the "use" of active compensating systems for rotor blade tip clearance control.

#### Note:

1094.4.f. does not embargo "software" embedded in unembargoed equipment or required for maintenance activities associated with the calibration or repair or updates to the active compensating clearance control system.

### 1095. Technology

1. Technology according to the General Technology Note for the "development" of equipment or "software" embargoed by 1091.1.c., 1091.4. to 1091.11., 1092. or 1094.;
2. Technology according to the General Technology Note for the "production" of equipment embargoed by 1091.1.c., 1091.4. to 1091.11. or 1092.

#### Note:

"Development" or "production" technology embargoed by 1095. for gas turbine engines remains embargoed when used as "use" technology for repair, rebuild and overhaul. Excluded from embargo are: technical data, drawings or documentation for maintenance activities directly associated with calibration, removal or replacement of damaged or unserviceable line replaceable units, including replacement of whole engines or engine modules.

(For technology for the repair of embargoed structures, laminates or materials, see 1015.2.f.)

3. Other technology, as follows:
  - a. Technology "required" for the "development" or "production" of the following gas turbine engine components or systems:

1. Gas turbine blades, vanes or tip shrouds made from directionally solidified (DS) or single crystal (SC) alloys having (in the 001 Miller Index Direction) a stress-rupture life exceeding 400 hours at 1,273 K (1,000°C) at a stress of 200 MPa, based on the average property values;
2. Multiple domed combustors operating at average burner outlet temperatures exceeding 1,643 K (1,370°C), or combustors incorporating thermally decoupled combustion liners, non-metallic liners or non-metallic shells;
3. Components manufactured from organic "composite" materials designed to operate above 588 K (315°C), or from metal "matrix" "composite", ceramic "matrix", intermetallic or intermetallic reinforced materials embargoed by 1011.2. or 1013.7.;
4. Uncooled turbine blades, vanes, tip-shrouds or other components designed to operate at gas path temperatures of 1,323 K (1,050°C) or more;
5. Cooled turbine blades, vanes or tip-shrouds, other than those described in 1095.3.a.1., exposed to gas path temperatures of 1,643 K (1,370°C) or more;
6. Airfoil-to-disk blade combinations using solid state joining;
7. Gas turbine engine components using "diffusion bonding" technology embargoed by 1025.3.b.;
8. Damage tolerant gas turbine engine rotating components using powder metallurgy materials embargoed by 1013.2.b.;
9. FADEC for gas turbine and combined cycle engines and their related diagnostic components, sensors and specially designed components;
10. Adjustable flow path geometry and associated control systems for:
  - a. Gas generator turbines;
  - b. Fan or power turbines;
  - c. Propelling nozzles;

#### Notes:

1. Adjustable flow path geometry and associated control systems do not include inlet guide vanes, variable pitch fans, variable stators or bleed valves for compressors.
2. 1095.3.a.10. does not embargo "development" or "production" technology for adjustable flow path geometry for reverse thrust.

11. Rotor blade tip clearance control systems employing active compensating casing technology limited to a design and development data base;
  12. Gas bearings for gas turbine engine rotor assemblies;
  13. Wide chord hollow fan blades without part-span support;
- b. Technology "required" for the "development" or "production" of:
    1. Wind tunnel aero-models equipped with non-intrusive sensors capable of transmitting data from the sensors to the data acquisition system;
    2. "Composite" propeller blades or propfans capable of absorbing more than 2,000 kW at flight speeds exceeding Mach 0.55;
  - c. Technology "required" for the "development" or "production" of gas turbine engine components using "laser", water jet or ECM/EDM hole drilling processes to produce holes with:
    1. a. Depths more than four times their diameter;
    - b. Diameters less than 0.76 mm; and
    - c. Incidence angles equal to or less than 25° or
    2. a. Depths more than five times their diameter;
    - b. Diameters less than 0.4 mm; and
    - c. Incidence angles of more than 25°;

#### Technical Note:

For the purposes of 1095.3.c., incidence angle is measured from a plane tangential to the airfoil surface at the point where the hole axis enters the airfoil surface.

- d. Technology "required" for the "development" or "production" of helicopter power transfer systems or tilt rotor or tilt wing "aircraft" power transfer systems:
  1. Capable of loss-of-lubrication operation for 30 minutes or more; or
  2. Having an input power-to-weight ratio equal to or more than 8.87 kW/kg.

1095. cont'd.

3. e. 1. Technology for the "development" or "production" of reciprocating diesel engine ground vehicle propulsion systems having all of the following:
- A box volume of 1.2 m<sup>3</sup> or less;
  - An overall power output of more than 750 kW based on 80/1269/EEC, ISO 2534 or national equivalents; **and**
  - A power density of more than 700 kW/m<sup>3</sup> of box volume;

**Technical Note:**

*Box volume: the product of three perpendicular dimensions measured in the following way:*

*Length: The length of the crankshaft from front flange to flywheel face;*

*Width: The widest of the following:*

- The outside dimension from valve cover to valve cover;
- The dimensions of the outside edges of the cylinder heads; **or**
- The diameter of the flywheel housing;

*Height: The largest of the following:*

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

- e. 2. Technology "required" for the "production" of specially designed components, as follows, for high output diesel engines:
- Technology "required" for the "production" of engine systems having all of the following components employing ceramics materials embargoed by 1013.7:
    - Cylinder liners;
    - Pistons;
    - Cylinder heads; **and**
    - One or more other components (including exhaust ports, turbochargers, valve guides, valve assemblies or insulated fuel injectors);

- Technology "required" for the "production" of turbocharger systems, with single-stage compressors having all of the following:
  - Operating at pressure ratios of 4:1 or higher;
  - A mass flow in the range from 30 to 130 kg per minute; **and**
  - Variable flow area capability within the compressor or turbine sections;
- Technology "required" for the "production" of fuel injection systems with a specially designed multifuel (e.g. diesel or jet fuel) capability covering a viscosity range from diesel fuel (2.5 cSt at 310.8 K (37.8°C)) down to gasoline fuel (0.5 cSt at 310.8 K (37.8°C)), having both of the following:
  - Injection amount in excess of 230 mm<sup>3</sup> per injection per cylinder; **and**
  - Specially designed electronic control features for switching governor characteristics automatically depending on fuel property to provide the same torque characteristics by using the appropriate sensors;
  - Technology "required" for the "development" or "production" of high output diesel engines for solid, gas phase or liquid film (or combinations thereof) cylinder wall lubrication, permitting operation to temperatures exceeding 723 K (450°C), measured on the cylinder wall at the top limit of travel of the top ring of the piston.

**Technical Note:**

*High output diesel engines: diesel engines with a specified brake mean effective pressure of 1.8 MPa or more at a speed of 2,300 r.p.m., provided the rated speed is 2,300 r.p.m. or more.*

**Statement of Understanding**

*It is understood that 1095.3.e.2.b. embargoes only technology "required" to achieve all of the parameters.*

*It is understood that 1095.3.e.2.c. embargoes only technology "required" for multifuel capability with all of the parameters.*

## Group 2 – International Munitions List

Definitions to the terms set out in quotations are listed in pages 49 to 55 of this Guide and apply in respect to this Group.

### 2000. General Technology Note

Member Governments have determined to restrict the export of "technology" applicable to the "development", "production" and "use" of products as defined in the International Lists.

This Note applies equally to "technology" specific to the integration or "use" of components in products as defined in the International List, even if the components themselves are unembargoed.

"Technology" covered by this Note remains restricted even when applicable to the "development", "production" and "use" of a non embargoed product.

This Note does not apply to that "technology" which is the minimum necessary for the installation, operation, maintenance (checking) and repair of those products whose export has been authorized.

This Note does not apply to "technology" "in the public domain" or to "basic scientific research".

### 2001. Small arms, automatic weapons and accessories, as follows, and specially designed components therefor:

- a. Rifles, carbines, revolvers, pistols, machine pistols and machine guns, except:
  1. muskets, rifles and carbines dated earlier than 1938;
  2. reproductions of muskets, rifles and carbines dated earlier than 1890;
  3. revolvers, pistols and machine guns dated earlier than 1890, and their reproductions;
- b. Smooth-bore weapons specially designed for military use
- c. Weapons using caseless ammunition;
- d. Silencers, special gun-mountings, clips and flash suppressors for arms embargoed by sub-items a., b or c.

#### Technical Note:

Smooth-bore weapons specially designed for military use as specified in sub-item b. are those which:

- a. Are proof tested at pressures above 1,300 bars;
- b. Operate normally and safely at pressures above 1,000 bars; **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. 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.
2. This Item does not embargo firearms specially designed for dummy ammunition and which are incapable of firing any embargoed ammunition.
3. 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, projectors and accessories, as follows, and specially designed components therefor:

- a. Guns, howitzers, cannon, mortars, anti-tank weapons, projectile launchers, military flame throwers, recoilless rifles and signature reduction devices therefor;

#### Note:

This sub-item includes injectors, metering devices, storage tanks and other specially designed components for use with liquid propelling charges for any of the equipment embargoed by this sub-item.

- b. Military smoke, gas and pyrotechnic projectors or generators.

#### Note:

This sub-item does not embargo signal pistols.

### 2003. Ammunition, and specially designed components therefor, for the weapons embargoed by Items 2001, 2002 or 2026.

#### Notes:

1. Specially designed components 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 embargo ammunition crimped without a projectile (blank star) and dummy ammunition with a pierced powder chamber.

### 2004. Bombs, torpedoes, rockets, missiles and accessories, as follows, specially designed for military use, and specially designed components therefor:

- a. Bombs, torpedoes, grenades, smoke canisters, rockets, mines, missiles, depth charges, demolition-charges, -devices and -kits, "military pyrotechnics", cartridges and simulators;

#### Note:

Sub-item a. includes:

1. Smoke grenades, fire bombs, incendiary bombs and explosive devices;
  2. Missile rocket nozzles and re-entry vehicle nosetips.
- b. Equipment specially designed for the handling, control, activation, powering with one-time operational output, launching, laying, sweeping, discharging, decoying, jamming, detonation or detection of items embargoed by sub-item a.

#### Note:

Sub-item b. includes:

1. Mobile gas liquefying equipment 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.

### 2005. Fire control, and related alerting and warning equipment, and related systems, as follows, specially designed for military use, and specially designed components or accessories therefor:

- a. Weapon sights, bombing computers, gun laying equipment and on-board weapon control systems;
- b. Target acquisition, designation, range-finding, surveillance or tracking systems; detection, recognition or identification equipment; **and** sensor integration equipment.

### 2006. Vehicles and related equipment, as follows, specially designed or modified for military use, and specially designed components 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 and vehicles fitted with mounting for arms;
- c. Armoured railway trains;
- d. Half-tracks;
- e. Recovery vehicles;
- f. Carriers, tractors and trailers specially designed for towing or transporting ammunition or weapon systems and related load handling equipment;
- g. Amphibious and deep water fording vehicles;
- h. Mobile repair shops specially designed to service military equipment;
- i. 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;
  - b. Engines and power transfer systems for the propulsion of the vehicles embargoed by sub-items a. to i., 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. Suspensions specially designed or modified for military use.
2. Vehicles embargoed by sub-item i. include tank transporters, tracked amphibious cargo carriers, high speed tractors, heavy artillery transporters, bridge laying vehicles and specialised bulk refuellers.

### 2007. Toxicological agents, "tear gases", related equipment, components, materials and technology as follows:

- a. Biological agents and radioactive materials "adapted for use in war" to produce casualties in men or animals, degrade equipment or damage crops or the environment, and chemical warfare (CW) agents;
- b. CW binary precursors, as follows:
  1. DF: Methyl Phosphonyldifluoride (CAS 676-99-3);
  2. QL: o-Ethyl-2-di-isopropylamino ethyl methylphosphonite (CAS 37836-11-8);
- c. "Tear gases" and "riot control agents" including:
  1. Bromobenzyl cyanide (CA);
  2. o-Chlorobenzylidenemalononitrile (o-Chlorobenzalmononitrile) (CS);
  3. Phenylacetyl chloride (w-chloroacetophenone) (CN);
- d. Equipment specially designed or modified for the dissemination of the materials or agents embargoed by a. and specially designed components therefor;
- e. Equipment specially designed or modified for defence against materials or agents embargoed by a., and specially designed components therefor;
- f. Equipment specially designed or modified for the detection or identification of materials or agents embargoed by a., and specially designed components therefor;
- g. "Biopolymers" specially designed or processed for the detection or identification of CW agents embargoed by a., and the cultures of specific cells used to produce them;
- h. "Biocatalysts" for the decontamination or degradation of CW agents, and biological systems therefor, as follows:
  1. "Biocatalysts" specially designed for the decontamination or degradation of CW agents embargoed by 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 h.1.;
- i. "Technology" as follows:
  1. "Technology" for the "development", "production" or "use" of toxicological agents, related equipment or components embargoed by a. to f.;
  2. "Technology" for the "development", "production" or "use" of "biopolymers" or cultures of specific cells embargoed by g.;
  3. "Technology" exclusively for the incorporation of "biocatalysts", embargoed by h.1., into military carrier substances or military material.

### Notes:

1. Sub-item a. includes the following CW agents:
  - a. o-Alkyl (equal to or less than C<sub>10</sub>, including cycloalkyl) alkyl (Methyl, Ethyl, n-Propyl or Isopropyl) - phosphonofluoridates, such as: Sarin (GB):o-Isopropyl methylphosphonofluoridate (CAS 107-44-8); and So man (GD):o-Pinacolyl methylphosphonofluoridate (CAS 96-64-0);
  - b. o-Alkyl (equal to or less than C<sub>10</sub>, including cycloalkyl) N,N-dialkyl (Methyl, Ethyl, n-Propyl or Isopropyl) phosphoramidocyanidates, such as: Tabun (GA):o-Ethyl N,N-dimethylphosphoramidocyanidate (CAS 77-81-6);
  - c. o-Alkyl (H or equal to or less than C<sub>10</sub>, including cycloalkyl) S-2-dialkyl (Methyl, Ethyl, n-Propyl or Isopropyl)-aminoethyl alkyl (Methyl, Ethyl, n-Propyl or Isopropyl) phosphonothiolates and corresponding alkylated and protonated salts, such as: VX: o-Ethyl S-2-diisopropylaminoethyl methyl phosphonothiolate (CAS 50782-69-9);

- d. Sulphur mustards, such as:
    - 2-Chloroethylchloromethylsulphide (CAS 2625-76-5);
    - Bis(2-chloroethyl) sulphide (CAS 505-60-2);
    - Bis(2-chloroethylthio) methane (CAS 63869-13-6);
    - 1,2-bis (2-chloroethylthio) ethane (CAS 3563-36-8);
    - 1,3-bis (2-chloroethylthio) -n-propane (CAS 63905-10-2);
    - 1,4-bis (2-chloroethylthio) -n-butane;
    - 1,5-bis (2-chloroethylthio) -n-pentane;
    - Bis (2-chloroethylthiomethyl) ether;
    - Bis (2-chloroethylthioethyl) ether (CAS 63918-89-8);
  - e. Lewisites, such as:
    - 2-chlorovinylchloroarsine (CAS 541-25-3);
    - Bis (2-chlorovinyl) chloroarsine (CAS 40334-69-8);
    - Tris (2-chlorovinyl) arsine (CAS 40334-70-1);
  - f. Nitrogen mustards, such as:
    - HN1: bis (2-chloroethyl) ethylamine (CAS 538-07-8);
    - HN2: bis (2-chloroethyl) methylamine (CAS 51-75-2);
    - HN3: tris (2-chloroethyl) amine (CAS 555-77-1);
  - g. 3-Quinuclidinyl benzilate (BZ) (CAS 6581-06-2).
2. Sub-item e. includes air conditioning units specially designed or modified for nuclear, biological or 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. Xylyl 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-items e. and f. do not embargo:
    - a. Personal radiation monitoring dosimeters;
    - b. Masks for protection against specific industrial hazards, such as fumes or powders in mining, quarrying or chemical plants;
    - c. Gas masks designed for civilian use.
  5. The technology, cultures of cells and biological systems listed in sub-items g., h.2. and i.3. are exclusive and these sub-items do not embargo technology, cells or biological systems for civil purposes, such as agricultural, pharmaceutical, medical, veterinary, environmental, waste management, or in the food industry.

### 2008. Military explosives and fuels, "additives" and "precursors" therefor; and liquid oxidizers, as follows:

- 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;
- e. Liquid oxidizers comprised of or containing inhibited red fuming nitric acid (IRFNA) or oxygen difluoride.

### Notes:

1. Military explosives and fuels are substances and mixtures which contain any of the materials in paragraph a. or meet any of the parameters in paragraph b. of this Note:
  - a. Contain any of the following materials:
    1. Spherical aluminium powder with a particle size of 60 µm or less, manufactured from material with an aluminium content of 99% or more;

2008. Notes cont'd.

1. a. 2. Metal fuels in particle sizes of less than 60 µm whether spherical, atomized, spheroidal, flaked or ground, manufactured from material consisting of 99% or more of any of the following: zirconium, magnesium and alloys of these; beryllium; fine iron powder with average particle size of 3 µm or less produced by reduction of iron oxide with hydrogen; boron or boron carbide fuels of 85% purity or higher and average particle size of 60 µm or less;
 

**N.B.:**  
The military explosives and fuels containing the metals or alloys listed in a.1. and a.2. above are embargoed whether or not the metals or alloys are encapsulated in aluminium, magnesium, zirconium or beryllium.

  3. Perchlorates, chlorates and chromates composited with powdered metal or other high energy fuel components;
  4. Nitroguanidine (NQ);
  5. Compounds composed of fluorine and any of the following: other halogens, oxygen, nitrogen;
  6. Carboranes; decaborane; pentaborane and derivatives;
  7. 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);
  8. Hexanitrostilbene (HNS);
  9. Diaminotrinitrobenzene (DATB);
  10. Triaminotrinitrobenzene (TATB);
  11. Triaminoguanidinenitrate (TAGN);
  12. Titanium subhydride of stoichiometry TiH 0.65-1.68;
  13. Dinitroglucoluril (DNGU, DINGU); tetranitroglucoluril (TNGU, SORGUYL);
  14. Tetranitrobenzotriazolobenzotriazole (TACOT);
  15. Diaminohexanitrobiphenyl (DIPAM);
  16. Picrylaminedinitropyridine (PYX);
  17. 3-nitro-1,2,4-triazol-5-one (NTO or ONTA);
  18. Hydrazine in concentrations of 70% or more; hydrazine nitrate; hydrazine perchlorates; unsymmetrical dimethyl hydrazine; monomethyl hydrazine; symmetrical dimethyl hydrazine;
  19. Ammonium perchlorate;
  20. Cyclotrimethylenetrinitramine (RDX); cyclonite; T4; hexahydro-1,3,5-trinitro-1,3,5-triazine; 1,3,5-trinitro-1,3,5-triaza-cyclohexane (hexogen, hexogene);
  21. Hydroxylammonium nitrate (HAN); hydroxylammonium perchlorate (HAP);
  22. 2-(5-cyanotetrazolato) penta ammine-cobalt (III) perchlorate (or CP);
  23. cis-bis (5-nitrotetrazolato) penta amine-cobalt (III) perchlorate (or BNCP)
  24. 7-Amino-4,6-dinitrobenzofurazane-1-oxide (ADNBF); amino dinitrobenzo-furoxan;
  25. 5,7-diamino-4,6-dinitrobenzofurazane-1-oxide, (CL-14) or diamino dinitrobenzofurozan);
  26. 2,4,6-trinitro-2,4,6-triaza-cyclo-hexanone (K-6 or Keto-RDX);
  27. 2,4,6,8-tetranitro-2,4,6,8-tetraaza-bicyclo (3,3,0)-octanone-3 (tetranitrosemiglycouril, K-55 or keto-bicyclic HMX);
  28. 1,1,3-trinitroazetidine (TNAZ);
  29. 1,4,5,8-tetranitro-1,4,5,8-tetraazadecalin (TNAD);
  30. Hexanitrohexaazaisowurtzitane (CL-20) or HNIW; **and** chlathrates of CL-20);
  31. Polynitrocubanes with more than four nitro groups;
  32. Ammonium dinitramide (ADN or SR 12);

b. Meet the following performance parameters:

  1. Any explosive with a detonation velocity exceeding 8,700 m/s or a detonation pressure exceeding 340 kilobars;
  2. Other organic high explosives not listed in this Note yielding detonation pressures of 250 kilobars or more that will remain stable at temperatures of 523 K (250°C) or higher for periods of 5 minutes or longer;
  3. Any other UN Class 1.1 solid propellant not listed in this Note with a theoretical specific impulse (under standard conditions) of more than 250 seconds for non-metallised, or more than 270 seconds for aluminised compositions;
  4. Any UN Class 1.3 solid propellant with a theoretical specific impulse of more than 230 seconds for non-halogenised, 250 seconds for non-metallised and 266 seconds for metallised compositions;
  5. Any other gun propellants not listed in this Note having a force constant of more than 1,200 kJ/kg;
  6. Any other explosive, propellant or pyrotechnic not listed in this Note that can sustain a steady-state burning rate of more than 38 mm per second under standard conditions of 68.9 bar pressure and 294 K (21°C); **or**
  7. Elastomer modified cast double based propellants (EMCDB) with extensibility at maximum stress of more than 5% at 233 K (-40°C).
2. "Additives" include the following:
  - a. Glycidylazide Polymer (GAP) and its derivatives;
  - b. Polycyanodifluoroaminoethyleneoxide (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-nitro-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 vinoxyl propane adduct (TVOPA);
  - k. Bisazidomethylloxetane and its polymers;
  - l. Nitratomethylmethylloxetane or poly (3-Nitratomethyl, 3-methyl oxetane); (Poly-NIMMO) (NMMO);
  - m. azidomethylmethylloxetane (AMMO) and its polymers;
  - n. Polynitroorthocarbonates;
  - o. Tetraethylenepentamineacrylonitrile (TEPAN); cyanoethylated polyamine and its salts;
  - p. Tetraethylenepentamineacrylonitrileglycidol (TEPANOL); cyanoethylated polyamine adducted with glycidol and its salts;
  - q. Polyfunctional aziridine amides: with isophthalic, trimesic (BITA); butyleneimine trimesamide isocyanuric; or trimethyladipic backbone structures and 2-methyl or 2-ethyl substitutions on the aziridine ring;
  - r. Basic copper salicylate; lead salicylate;
  - s. Lead beta resorcyrate;
  - t. Lead stannate, lead maleate, lead citrate;
  - u. Tris-1-(2-methyl)aziridinyl phosphine oxide (MAPO); bis(2-methyl aziridinyl) 2-(2-hydroxypropanoxy) propylamino phosphine oxide (BOBBA 8); **and** other MAPO derivatives;
  - v. bis(2-methyl aziridinyl) methylamino phosphine oxide (Methyl BAPO);
  - w. Organo-metallic coupling agents, specifically:
    1. Neopentyl [diallyl] oxy, tri [diocetyl] phosphato titanate ; also known as titanium IV, 2,2[bis 2-propenolato-methyl, butanolate or tris [diocetyl] phosphato-O], or LICA 12;
    2. Titanium IV, [(2-propenolato-1) methyl, N-propanolatomethyl] butanolato-1, also known as tris[diocetyl]pyrophosphato or KR3538;
    3. Titanium IV, [(2-propenolato-1)methyl, N-propanolatomethyl] butanolato-1, also known as tris(diocetyl)phosphato or KR3512;
  - x. FPF-1 poly-2,2,3,3,4,4-hexafluoropentane-1,5-diol formal;
  - y. FPF-3poly-2,4,4,5,5,6,6-heptafluoro-2-tri-fluoromethyl-3-oxaheptane-1,7-diol formal;
  - z. Polyglycidyl nitrate or poly (Nitratomethyl oxirane); (Poly-GLYN) (PGN);
  - aa. Hydroxyl terminated polybutadiene (HTPB) with a hydroxyl functionality of less than 2.16, a hydroxyl value of less than 0.77 meq/g, and a viscosity at 30°C of less than 47 poise;
  - bb. Lead-copper chelates of beta-resorcyrate or salicylates;
  - cc. Triphenyl bismuth (TPB);
  - dd. Bis-2-hydroxyethylglycolamide (BHEGA);
  - ee. Superfine iron oxide (Fe<sub>2</sub>O<sub>3</sub>, hematite) with a specific surface area more than 250 m<sup>2</sup>/g and an average particle size of 0.003 µm or less;
  - ff. N-Methyl-p-Nitroaniline.
3. Aircraft fuels embargoed by sub-item d. are finished products not their constituents.
4. Sub-item d. includes military materials containing thickeners for hydrocarbon fuels specially formulated for use in flamethrowers or incendiary munitions, such as metal stearates or palmates (also known as octol) and M1, M2, M3 thickeners.

5. "Precursors" include the following:
  - a. Guanidine nitrate;
  - b. 1,2,4 trihydroxybutane (1,2,4-butanetriol);
  - c. 1,3,5-trichlorobenzene;
  - d. Bischloromethyloxetane (BCMO);
  - e. Low (less than 10,000) molecular weight, alcohol-functionalised, poly(epichlorohydrin); poly(epichlorohydrindiol) and triol;
  - f. Propyleneimide, 2-methylaziridine;
  - g. 1,3,5,7 tetraacetyl-1,3,5,7-tetraaza cyclo-octane (TAT);
  - h. Dinitroazetidone-t-butyl salt;
  - i. Hexabenzylhexaazaisowurtzitane (HBIW);
  - j. Tetraacetyldibenzylhexaazaisowurtzitane (TAIW);
  - k. 1,4,5,8 Tetraazadecaline.
6. This item does not embargo those "precursors" that are industrial chemicals, not embargoed elsewhere in the International Lists, widely available in international markets.
7. This item does not embargo the following substances when not compounded or mixed with military explosives or powdered metals:
  - a. Ammonium picrate;
  - b. Black powder;
  - c. Hexanitrodiphenylamine;
  - d. Difluoroamine (HNF<sub>2</sub>);
  - e. Nitrostarch;
  - f. Potassium nitrate;
  - g. Tetranitronaphthalene;
  - h. Trinitroanisole;
  - i. Trinitronaphthalene;
  - j. Trinitroxylene;
  - k. Fuming nitric acid non-inhibited and not enriched;
  - l. Trinitrophenylmethyl nitramine (tetryl);
  - m. Acetylene;
  - n. Propane;
  - o. Liquid oxygen;
  - p. Hydrogen peroxide in concentrations of less than 85%;
  - q. Misch metal;
  - r. N-pyrrolidone; 1-methyl-2-pyrrolidone;
  - 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; methylethyldiphenyl 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;
  - kk. Chlorinetrifluoride.

**2009. Vessels of war, special naval equipment and accessories, as follows, and specially designed components thereof:**

- a. Combatant vessels and vessels (surface or underwater) specially designed or modified for offensive or defensive action, whether or not converted to non-military use, regardless of current state of repair or operating condition, and whether or not they contain weapon delivery systems or armour, 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 hp.) 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 hp.);
      - b. Quick reversing;
      - c. Liquid cooled; **and**
      - d. Totally enclosed;
    3. Non-magnetic diesel engines specially designed for military use with a power output of 37.3 kW (50 hp.) or more and with a non-magnetic content in excess of 75% of total mass;
  - c. Underwater detection devices specially designed for military use and controls thereof;
  - d. Submarine and torpedo nets;
  - e. Equipment for guidance and navigation specially designed for military use;
  - f. Hull penetrators and connectors specially designed for military use 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 and optical hull penetrators specially designed for "laser" beam transmission regardless of depth. It does not include ordinary propulsive shaft and hydrodynamic control-rod hull penetrators.*
- g. Silent bearings specially designed for military use and equipment containing those bearings.

**2010. "Aircraft", unmanned airborne vehicles, aero-engines and "aircraft" equipment, related equipment and components, specially designed or modified for military use, as follows:**

- a. Combat "aircraft" and specially designed components thereof;
- b. Other "aircraft" specially designed or modified for military use, including military reconnaissance, assault, military training, transporting and airdropping troops or military equipment, logistics support, and specially designed components thereof;
- c. Aero-engines specially designed or modified for military use, and specially designed components thereof;
- d. Unmanned airborne vehicles, including remotely piloted air vehicles (RPVs), and autonomous, programmable vehicles specially designed or modified for military use and their launchers, ground support and related equipment for command and control;
- e. Airborne equipment, including airborne refuelling equipment, specially designed for use with the "aircraft" embargoed by a. or b. or the aero-engines embargoed by c., and specially designed components thereof;
- f. Pressure refuellers, pressure refuelling equipment, equipment specially designed to facilitate operations in confined areas and ground equipment, developed specially for "aircraft" embargoed by a. or b., or for aero-engines embargoed by c.;
- g. Pressurised breathing equipment and partial pressure suits for use in "aircraft", anti-g suits, military crash helmets and protective masks, liquid oxygen converters used for "aircraft" or missiles, and catapults and cartridge actuated devices for emergency escape of personnel from "aircraft";
- h. Parachutes used for combat personnel, cargo dropping or "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 or space vehicles;
6. Approach parachutes and landing deceleration parachutes;
7. Other military parachutes;
- i. Automatic piloting systems for parachuted loads; equipment specially designed or modified for military use for controlled opening jumps at any height, including oxygen equipment.

**Notes:**

1. Sub-item b. does not embargo "aircraft" designed or modified for military use which have been certified for civil use by the civil aviation authorities in a member country and which are equipped to international civilian standards, or specially designed components therefor.
2. Sub-item c. does not embargo:
  - a. Aero-engines designed or modified for military use which have been certified by civil aviation authorities in a member country for use in "civil aircraft", or specially designed components therefor;
  - b. Reciprocating engines or specially designed components therefor.
3. The embargo in sub-items b. and c. on specially designed components and related equipment for non-military "aircraft" or aero-engines modified for military use applies only to those military components and to military related equipment required for the modification to military use.

**2011. Electronic equipment not embargoed elsewhere on this List specially designed for military use and specially designed components therefor:**

**Note:**

This Item includes:

- a. Jamming and counter-jamming equipment, including electronic counter measure and electronic counter-counter measure equipment (i.e. equipment 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. Frequency agile tubes;
- c. 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;
- d. Underwater counter measure, including acoustic and magnetic jamming and decoy, equipment designed to introduce extraneous or erroneous signals into sonar receivers;
- e. Data processing security equipment, data security equipment and transmission and signalling line security equipment, using ciphering processes;
- f. Identification, authentication and keyloader equipment and key management, manufacturing and distribution equipment.

**2013. Armoured or protective equipment and constructions, 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 or to construct military shelters.
2. Sub-item c. does not embargo conventional steel helmets not equipped with, modified or designed to accept any type of accessory device.

**2014. Specialised equipment for military training or for simulating military scenarios, specially designed components and accessories therefor:**

**Note:**

1. The term 'specialised equipment for military training' 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, missile launch trainers, target equipment, drone "aircraft", armament trainers, pilotless "aircraft" trainers and mobile training units.
2. This Item includes image generating and interactive environment systems for simulators when specially designed or modified for military use.

**2015. Imaging or countermeasure equipment, as follows, specially designed for military use, and specially designed components and accessories therefor:**

**Note:**

This Item does not embargo first generation image intensifier tubes.

- a. Recorders and image processing equipment;
- b. Cameras, photographic equipment and film processing equipment;
- c. Image intensifier equipment;
- d. Infrared or thermal imaging equipment;
- e. Imaging radar sensor equipment;
- f. Countermeasure or counter-countermeasure equipment for the equipment embargoed by sub-items a. to e.

(See also Category 1061.A.2.a.2. and 1061.A.2.b.)

**Notes:**

1. The term 'specially designed components' includes the following when specially designed for military use:
  - a. Infrared image converter tubes;
  - b. Image intensifier tubes (other than first generation);
  - c. Microchannel plates;
  - d. Low-light-level television camera tubes;
  - e. Detector arrays (including electronic interconnection or read out systems);
  - f. Pyroelectric television camera tubes;
  - g. Cooling systems for imaging systems;
  - h. Electrically triggered shutters of the photochromic or electro-optical type having a shutter speed of less than 100  $\mu$ s, except shutters which are an essential part of a high speed camera;
  - i. Fibre optic image inverters;
  - j. Compound semiconductor photocathodes.
2. Sub-item f. includes equipment designed to degrade the operation or effectiveness of military imaging systems or to minimize such degrading effects.

**2016. Forgings, castings and semi-finished products specially designed for the products embargoed by Items 2001, 2002, 2003, 2004, 2006, 2010, 2023 or 2026 on this List.**

**2017. Miscellaneous equipment, materials and libraries, as follows, and specially designed components therefor:**

- a. Self-contained diving and underwater swimming apparatus, as follows:
  1. Closed or semi-closed circuit (rebreathing) apparatus;
  2. Specially designed components for use in the conversion of open-circuit apparatus to military use;
  3. Articles designed exclusively for military use with self-contained diving and underwater swimming apparatus;

- b. Construction equipment specially designed for military use;
- c. Fittings, coatings and treatments for signature suppression, specially designed for military use;
- d. Field engineer equipment specially designed for use in a combat zone;
- e. "Robots", "robot" controllers and "robot" "end-effectors", having any of the following characteristics:
  - 1. Specially designed for military use;
  - 2. 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);
  - 3. Operable at altitudes exceeding 30,000 m; **or**
  - 4. Specially designed or rated for operating in an electro-magnetic pulse (EMP) environment;
- f. Libraries (parametric technical databases) specially designed for military use with equipment embargoed by this List;

**Technical Note:**

For the purpose of this Item, the term 'library' (parametric technical database) means a collection of technical information of a military nature, reference to which may enhance the performance of military equipment or systems.

**2018. Equipment and technology for the "production" of products referred to in this List, as follows:**

- a. Specially designed or modified "production" equipment for the "production" of products embargoed by this List, 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 this List;
- 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.

**Note:**

- 1. Sub-items a. and b. include the following equipment:
  - a. Continuous nitrotrators;
  - b. Centrifugal testing apparatus or equipment having any of the following characteristics:
    - 1. Driven by a motor or motors having a total rated horsepower of more than 298 kW (400 hp);
    - 2. Capable of carrying a payload of 113 kg or more; **or**
    - 3. Capable of exerting a centrifugal acceleration of 8 g or more on a payload of 91 kg or more;
  - c. Dehydration presses;
  - d. Screw extruders specially designed or modified for military explosive extrusion;
  - e. Cutting machines for the sizing of extruded propellants;
  - f. Sweetie barrels (tumblers) 1.85 m and over in diameter and having over 227 kg product capacity;
  - g. Continuous mixers for solid propellants;
  - h. Fluid energy mills for grinding or milling the ingredients of military explosives;
  - i. Equipment to achieve both sphericity and uniform particle size in metal powder listed in Note 1.a.1 to Item 2008;
  - j. Convection current converters for the conversion of materials listed in Note 1.a.6. to Item 2008.
- 2. a. The term 'products referred to in this List' includes:
  - 1. Products not embargoed if inferior to specified concentrations as follows:
    - a. hydrazine (see Note 1.a.18. to Item 2008);
    - b. "Military high explosives" (see Item 2008);
  - 2. Products not embargoed if inferior to technical limits, i.e. "superconductive" materials not embargoed by Category 1013.5 on the Industrial List; "superconductive" electromagnets not embargoed by Category 1031.1.e.3. on the Industrial List; "superconductive" electrical equipment excluded from embargo under Item 2020 b.;
  - 3. Metal fuels and oxidants deposited in laminar form from the vapour phase (see Note 1.a.2. to Item 2008);

- b. The term 'products referred to in this List' does not include:
  - 1. Signal pistols (see Item 2002.b.);
  - 2. The substances excluded from embargo under Note 2 to Item 2007;
  - 3. Personal radiation monitoring dosimeters and masks for protection against specific industrial hazards (see Note 4 to Item 2007);
  - 4. Acetylene, propane, liquid oxygen, difluoramine (HNF<sub>2</sub>), fuming nitric acid and potassium nitrate powder (see Note 7 to Item 2008);
  - 5. Aero-engines excluded from embargo under Item 2010;
  - 6. Conventional steel helmets not equipped with, or modified or designed to accept, any type of accessory device (see Note 2 to Item 2013);
  - 7. Equipment fitted with unembargoed industrial machinery, such as coating machinery not elsewhere specified and equipment for the casting of plastics;
  - 8. Muskets, rifles and carbines dated earlier than 1938, reproductions of muskets, rifles and carbines dated earlier than 1890, revolvers, pistols and machine guns dated earlier than 1890, and their reproductions; (Note 2.b.8. 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. does not include technology for civil purposes, such as agricultural, pharmaceutical, medical, veterinary, environmental, waste management, or in the food industry (see Note 5 to Item 2007).

**2020. Cryogenic and "superconductive" equipment, as follows, and specially designed components and accessories therefor:**

- a. Equipment specially designed or configured to be installed in a vehicle for military ground, marine, airborne or space applications, capable of operating while in motion and of producing or maintaining temperatures below 103 K (-170°C);

**Note:**

Sub-item a. includes mobile systems incorporating or employing accessories or components manufactured from non-metallic or non-electrical conductive materials, such as plastics or epoxy-impregnated materials.

- 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, capable of operating while in motion.

**Note:**

Sub-item b. does not embargo 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.

**2023. Directed energy weapon systems (DEW), related or countermeasure equipment and test models, as follows, and specially designed components 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. Equipment specially designed for the detection or identification of, or defence against, systems embargoed by a., b. or c.;
- e. Physical test models and related test results for the systems, equipment and components embargoed by this Item.

**Note:**

1. *Directed energy weapon systems 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.*
2. *This Item includes the following when specially designed for directed energy weapon systems:*
  - a. *Prime power generation, energy storage, switching, power conditioning or fuel-handling equipment;*
  - b. *Target acquisition or tracking systems;*
  - c. *Systems capable of assessing target damage, destruction or mission-abort;*
  - d. *Beam-handling, propagation or pointing equipment;*
  - e. *Equipment with rapid beam slew capability for rapid multiple target operations;*
  - f. *Adaptive optics and phase conjugators;*
  - g. *Current injectors for negative hydrogen ion beams;*
  - h. *"Space qualified" accelerator components;*
  - i. *Negative ion beam funnelling equipment;*
  - j. *Equipment for controlling and slewing a high energy ion beam;*
  - k. *"Space qualified" foils for neutralising negative hydrogen isotope beams.*

**2024. "Software", as follows:**

- a. "Software" specially designed or modified for the "development", "production" or "use" of equipment or materials embargoed by this List;

b. Specific "software", as follows:

1. "Software" specially designed for:
  - a. Modelling, simulation or evaluation of military weapon systems;
  - b. Development, monitoring, maintenance or up-dating of "software" embedded in military weapon systems;
  - c. Modelling or simulating military operation scenarios, not embargoed by Item 2014;
  - d. Command, Communications, Control and Intelligence (C<sup>3</sup>I) applications;
2. "Software" for determining the effects of conventional, nuclear, chemical or biological warfare weapons.

**2026. Kinetic energy weapon systems and related equipment, as follows, and specially designed components therefor:**

- a. Kinetic energy weapon 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;  
*(For weapon systems using sub-calibre ammunition or employing solely chemical propulsion, and ammunition therefor, see Items 2001,2002, 2003 and 2004).*

**Note:**

1. *This Item includes the following when specially designed for kinetic energy weapon systems:*
  - a. *Launch propulsion systems capable of accelerating masses larger than 0.1 g to velocities in excess of 1.6 km/s, in single or rapid fire modes;*
  - b. *Prime power generation, electric armour, energy storage, thermal management, conditioning, switching or fuel-handling equipment; and electrical interfaces between power supply, gun and other turret electric drive functions;*
  - c. *Target acquisition, tracking, fire control or damage assessment systems;*
  - d. *Homing seeker, guidance or divert propulsion (lateral acceleration) systems for projectiles.*
2. *This Item embargoes weapon 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).*
3. *This Item does not embargo technology for magnetic induction for continuous propulsion of civil transport devices.*

## Group 3 – International Atomic Energy List

Definitions to the terms set out in quotations are listed in pages 49 to 55 of this Guide and apply in respect to this Group.

### 3000. General Technology Note

Member Governments have determined to restrict the export of "technology" applicable to the "development", "production" and "use" of products as defined in the International Lists, including those subject to Administrative Exceptions Notes and those for which shipments are permitted without reporting to the Committee. This Note applies equally to "technology" specific to the integration or "use" of components in products as defined in the International List, even if the components themselves are unembargoed.

"Technology" covered by this Note remains restricted even when applicable to the "development", "production" and "use" of an unembargoed product.

This Note does not apply to that "technology" which is the minimum necessary for the installation, operation, maintenance (checking) and repair of those products whose export has been authorized.

This Note does not apply to "technology" "in the public domain" or to "basic scientific research".

## A. Nuclear Materials

### Technical Notes

#### 1. Raw materials

The embargo on raw materials covers all materials from which the metal can be usefully extracted, i.e. ores, concentrates, matte, regulus, residues and dross (ashes).

#### 2. Metals and alloys

Unless provision to the contrary is made, the words 'metals' and 'alloys' cover crude and semi-fabricated forms, as follows: Crude forms: Anodes, balls, bars (including notched bars and wire bars), billets, blocks, blooms, bricks, cakes, cathodes, crystals, cubes, dice, grains, granules, ingots, lumps, pellets, pigs, powder, rondelles, shot, slabs, slugs, sponge, sticks; Semi-fabricated forms (whether or not coated, plated, drilled or punched):

- a. Wrought or worked materials fabricated by rolling, drawing, extruding, forging, impact extruding, pressing, graining, atomising, and grinding, i.e.: angles, channels, circles, discs, dust, flakes, foils and leaf, forging, plate, powder, pressings and stampings, ribbons, rings, rods (including bare welding rods, wire rods, and rolled wire), sections, shapes, sheets, strip, pipe and tubes (including tube rounds, squares, and hollows), drawn or extruded wire;
- b. Cast material produced by casting in sand, die, metal, plaster or other types of moulds, including high pressure castings, sintered forms, and forms made by powder metallurgy.

The object of the embargo should not be defeated by the export of non-listed forms alleged to be finished products but representing in reality crude forms or semi-fabricated forms.

### 3001. "Special fissile materials" and other fissile materials, except:

- a. Shipments of one "effective gramme" or less;
- b. Shipments of four "effective grammes" or less when contained in a sensing component in instruments.

### 3002. Natural or depleted uranium in the forms of metal, hexafluoride, tetrafluoride or tetrachloride, except:

- a. Shipments having a natural uranium content in any of the forms described above, of:
  1. 10 kg or less for any application; or
  2. 100 kg or less for civil non-nuclear applications;
- b. Uranium depleted in the isotope 235 in which the uranium 235 isotope comprises less than 0.35 weight percent (o/w) of the total uranium assay;

### c. Depleted uranium specially fabricated for the following civil applications:

1. Ionising radiation shielding;
2. Packaging;
3. Ballasts;
4. Counter-weights.

(For titanium-uranium alloys, see International Industrial List Category 1013.4.)

### 3003. Deuterium, heavy water, deuterated paraffins, and simple or complex lithium deuterides, and mixtures and solutions containing deuterium, in which the isotopic ratio of deuterium to hydrogen exceeds 1: 5,000, except shipments of the above having a deuterium content of 10 kg or less.

### 3004. Zirconium metal; alloys containing more than 50 weight percent (o/w) zirconium; compounds in which the ratio of hafnium to zirconium is less than 1:500 parts by weight; and manufactures wholly thereof; except:

- a. Zirconium metal, alloys or compounds in shipments of 5 kg or less;
- b. Zirconium in the form of foil or strip having a thickness not exceeding 0.10 mm, in shipments of 200 kg or less.

### 3005. Nickel powder and porous nickel metal, as follows:

- a. Powder with a nickel purity content of 99.9 weight percent (o/w) or more and a mean particle size of less than 10 µm measured by the ASTM B 330 standard and a high degree of particle size uniformity;
- b. Porous nickel metal produced from materials embargoed by 3005.a. except single porous nickel metal sheets not exceeding 930 cm<sup>2</sup> intended for use in batteries for civil applications.

#### Note:

3005.b. refers to porous nickel metal manufactured from nickel powder defined in 3005.a. which has been compacted and sintered to form a metal material with fine pores interconnected throughout the structure.

### 3006. Nuclear-grade graphite, i.e. graphite having an impurity level of less than one part per million boron equivalent and with a density greater than 1.5 g/cm<sup>3</sup>, except individual shipments of 100 kg or less.

### 3007. Lithium, as follows:

- a. Metal, hydrides or alloys containing lithium enriched in lithium 6 to a concentration higher than the one existing in nature (7.5 weight percent (o/w));
- b. Any other materials containing lithium enriched in lithium 6 (including compounds, mixtures and concentrates), except lithium enriched in the 6 isotope incorporated in thermoluminescent dosimeters.  
(For the deuteride of natural lithium or of lithium enriched in lithium 7, see 3003.)

### 3008. Hafnium, as follows: metal, alloys and compounds of hafnium containing more than 60 weight percent (o/w) hafnium, and manufactures thereof, except shipments of the above having a hafnium content of 1 kg or less.

### 3009. Beryllium, as follows: metal, alloys containing more than 50 weight percent (o/w) beryllium by weight, compounds containing beryllium and manufactures thereof, except:

- a. Metal windows for X-ray machines;
- b. Oxide shapes in fabricated or semi-fabricated forms specially designed for electronic component parts or as substrates for electronic circuits;
- c. Shipments of 500 g or less of beryllium having a purity of 99% or less, or 100 g or less of beryllium having a purity of greater than 99%, provided shipments exclude single crystals;
- d. Shipments of 5 kg or less of beryllium contained in compounds with a purity of less than 99%.

**3012. Tritium, compounds and mixtures containing tritium in which the ratio of tritium to hydrogen by atoms exceeds 1 part in 1,000, and products containing one or more of the foregoing, except:**

- a. Shipments of tritium, compounds, mixtures and individual products containing one or more of the foregoing substances not exceeding 100 curies;
- b. Tritium contained in luminous paint, self-luminous products, gas and aerosol detectors, electron tubes, lightning or static elimination devices, ion generating tubes, detector cells of gas chromatography devices, and calibration standards;
- c. Compounds and mixtures of tritium, where the separation of the constituents cannot result in the evolution of an isotopic mixture of hydrogen in which the ratio of tritium to hydrogen by atoms exceeds 1 part in 1,000.

**3013. Materials for nuclear heat sources, as follows:**

- a. Plutonium in any form with a plutonium isotopic assay of plutonium-238 of more than 50 weight percent (o/w), except:
  1. Shipments with a plutonium content of one gramme or less;
  2. Shipments of three "effective grammes" or less when contained in a sensing component in instruments;
- b. "Previously separated" neptunium-237 in any form, except shipments with a neptunium-237 content of one gramme or less.

**3015. Wet-proofed platinized catalysts specially designed or prepared for promoting hydrogen isotope exchange between hydrogen and water for the recovery of tritium from heavy water or for heavy water production.**

## B. Nuclear Facilities

**3101. Plants for the separation of isotopes of natural and depleted uranium, "special fissile materials" and other fissile materials, and specially designed or prepared equipment and components therefor, as follows:**

- a. Plants specially designed for separating isotopes of natural and depleted uranium, "special fissile materials" and other fissile materials, as follows:
  1. Gaseous diffusion separation plants;
  2. Gas centrifuge separation plants;
  3. Aerodynamic separation plants;
  4. Chemical exchange separation plants;
  5. Ion-exchange separation plants;
  6. Atomic vapour "laser" isotopic separation plants;
  7. Molecular "laser" isotopic separation plants;
  8. Plasma separation plants;
  9. Electromagnetic separation plants;
- b. Equipment and components, as follows, specially designed or prepared for:
  1. Gaseous diffusion separation process:
    - a. Valves wholly made of or lined with aluminium, aluminium alloys, nickel or alloy containing 60 weight percent (o/w) or more nickel, 40 mm or more in diameter, with bellows seals;
    - b. Blowers and compressors (turbo, centrifugal and axial flow types) wholly made of or lined with aluminium, aluminium alloys, nickel or alloy containing 60 weight percent (o/w) or more nickel and having a capacity of 1,700 litres (1.7 m<sup>3</sup>) per minute or more, including compressor seals;
    - c. Gaseous diffusion barriers made of porous metallic, polymer or ceramic materials resistant to corrosion by uranium hexafluoride (UF<sub>6</sub>) with a pore size of less than 1,000 angstroms, a thickness of 5 mm or less, and, for tubular forms, a diameter of 25 mm or less;
    - d. Gaseous diffuser housings;
    - e. Heat exchangers made of aluminium, copper, nickel or alloy containing more than 60 weight percent (o/w) nickel, or combinations of these metals as clad tubes, designed to operate at sub-atmospheric pressure with a leak rate that limits the pressure rise to less than 10 pascal (0.1 millibar) per hour under a pressure differential of 10<sup>5</sup> pascal (1 bar);

2. Gas centrifuge separation process:
  - a. Gas centrifuges;
  - b. Complete rotor assemblies;
  - c. Rotor tube cylinders with a thickness of 12 mm or less, a diameter of between 75 mm and 400 mm made from high strength-to-density ratio materials described in the Technical Note 3101.b.2;
  - d. Magnetic suspension bearings consisting of an annular magnet suspended within a housing containing a damping medium (the magnet couples with a pole piece or second magnet fitted to the top cap of the rotor);
  - e. Specially prepared bearings comprising a pivot-cup assembly mounted on a damper;
  - f. Rings or bellows with a wall thickness of 3 mm or less and a diameter of between 75 mm and 400 mm and designed to give local support to a rotor tube or to join a number together, made from high strength-to-density ratio materials described in the Technical Note 3101.b.2;
  - g. Baffles with a diameter of between 75 mm and 400 mm for mounting inside the rotor tube, made from high strength-to-density ratio materials described in the Technical Note 3101.b.2;
  - h. Top and bottom caps with a diameter of between 75 mm and 400 mm to fit the ends of the rotor tube, made from high strength-to-density ratio materials described in the Technical Note 3101.b.2;
  - i. Molecular pumps comprised of cylinders having internally machined or extruded helical grooves and internally machined bores;
  - j. Ring-shaped motor stators for multiphase AC hysteresis (or reluctance) motors for synchronous operation within a vacuum in the frequency range of 600 to 2,000 Hz and a power range of 50 to 1,000 Volt-Amps;
  - k. Frequency changers (converters or inverters) specially designed or prepared to supply motor stators for gas centrifuge enrichment, having all of the following characteristics, and specially designed components therefor:
    1. Multiphase output of 600 Hz to 2 kHz;
    2. Frequency control better than 0.1%;
    3. Harmonic distortion of less than 2%; and
    4. An efficiency of more than 80%;

**Technical Note:**

The high strength-to-density ratio materials used for centrifuge rotating components are:

- a. Maraging steel capable of an ultimate tensile strength of  $2.05 \times 10^9$  N/m<sup>2</sup> or more;
- b. Aluminium alloys capable of an ultimate tensile strength of  $0.46 \times 10^9$  N/m<sup>2</sup> or more; or
- c. "Fibrous and filamentary materials" with a specific modulus of more than  $3.18 \times 10^6$  m and a specific tensile strength exceeding  $7.62 \times 10^4$  m.

**N.B.:**

1. Specific modulus: Young's modulus in pascals, equivalent to N/m<sup>2</sup> divided by specific weight in N/m<sup>3</sup>, measured at a temperature of  $(296 \pm 2)$  K ( $(23 \pm 2)^\circ$ C) and a relative humidity of  $(50 \pm 5)\%$ .
2. Specific tensile strength: ultimate tensile strength in pascals, equivalent to N/m<sup>2</sup> divided by specific weight in N/m<sup>3</sup>, measured at a temperature of  $(296 \pm 2)$  K ( $(23 \pm 2)^\circ$ C) and a relative humidity of  $(50 \pm 5)\%$ .
3. Aerodynamic separation process:
  - a. Separation nozzles consisting of slit-shaped, curved channels having a radius of curvature less than 1 mm (contained within the nozzle is a knife-edge which separates gas flowing through the nozzle into two streams);
  - b. Tangential inlet flow-driven cylindrical or conical tubes, specially designed for uranium isotope separation;
  - c. UF<sub>6</sub>-hydrogen helium compressors wholly made of or lined with aluminium, aluminium alloys, nickel or alloy containing 60 weight percent (o/w) or more nickel, including compressor seals;
  - d. Aerodynamic separation element housings, designed to contain vortex tubes or separation nozzles;

### 3101. cont'd.

- b. 3. e. Heat exchangers made of aluminium, copper, nickel or alloy containing more than 60 weight percent (o/w) nickel, or combinations of these metals as clad tubes, designed to operate at pressures of  $6 \times 10^5$  pascal (6 bar) or less;
4. Chemical exchange separation process:
  - a. Fast-exchange liquid-liquid centrifugal contactors or fast exchange liquid-liquid pulse columns made of fluorocarbon lined materials;
  - b. Electrochemical reduction cells designed to reduce uranium from one valence state to another;
5. Ion-exchange separation process, including fast reacting ion-exchange resins: pellicular, reticulated resins in which the active chemical exchange groups are limited to a coating on the surface of an inert particle or fibre;
6. Atomic vapour "laser" isotopic separation process:
  - a. High power electron beam guns with total power of more than 50 kW and strip or scanning electron beam guns with a delivered power of more than 2.5 kW/cm for use in uranium vaporization systems;
  - b. Trough shaped crucible and cooling equipment for molten uranium;
  - c. Product and tails collector systems made of or lined with materials resistant to the heat and corrosion of uranium vapour, such as yttria-coated graphite;
7. Molecular "laser" isotopic separation process:
  - a. Para-hydrogen Raman shifters designed to operate at 16  $\mu\text{m}$  output wavelength and at a repetition rate of more than 250 Hz;
  - b. Supersonic expansion nozzles designed for  $\text{UF}_6$  carrier gas;
  - c. Uranium fluoride ( $\text{UF}_5$ ) product filter collectors;
  - d. Equipment for fluorinating  $\text{UF}_5$  to  $\text{UF}_6$ ;
  - e.  $\text{UF}_6$  carrier gas compressors wholly made of or lined with aluminium, aluminium alloys, nickel or alloy containing 60 weight percent (o/w) or more nickel, including compressor seals;
8. Plasma separation process:
  - a. Product and tails collectors made of or lined with materials resistant to the heat and corrosion of uranium vapour such as yttria-coated graphite;
  - b. Radio frequency ion excitation coils for frequencies of more than 100 kHz and capable of handling more than 40 kW power;
9.  $\text{UF}_6$  mass spectrometers or ion sources specially designed or prepared for taking on-line samples of feed, product or tails from  $\text{UF}_6$  gas streams and having all of the following characteristics:
  - a. Unit resolution for mass of more than 320;
  - b. Ion sources constructed of or lined with nichrome or monel, or nickel plated; **and**
  - c. Electron bombardment ionization sources.

#### Technical Notes:

1. The following "lasers" and components are important in the atomic vapour "laser" isotopic separation process referred to in 3101.b.6.:
  - a. "Lasers" to pump dye "lasers":
    1. Copper vapour "lasers" of 40 W or more;
    2. Argon ion "lasers" of more than 40 W;
    3. ND:YAG "lasers" that can be frequency doubled and thereby have an average power of more than 40 W;
  - b. Other "lasers" and accessories:
    1. "Tunable" pulsed dye "laser" amplifiers and oscillators, except single-mode oscillators, with an average power of more than 30 W, a repetition rate of more than 1 kHz and a wavelength between 500 nm and 700 nm;
    2. Modulators for controlling and modifying dye "laser" bandwidth;
    3. "Tunable" pulsed single-mode dye oscillators capable of an average power of more than 1 W, a repetition rate of more than 1 kHz, a pulse width less than 100 ns, a wavelength between 500 nm and 700 nm and frequency modulation for bandwidth expansion.  
(For the embargo status of "lasers", see International Industrial List Category 1061.5.)
2. The following "lasers" are important in the molecular "laser" isotopic separation process referred to in 3101.b.7.:
  - a. Alexandrite "lasers" with a bandwidth of 0.005 nm (3 GHz) or less, a repetition rate of more than 125 Hz, and an average power of more than 30 W;

- b. Pulsed carbon dioxide "lasers" with a repetition rate of more than 250 Hz, an average power of more than 1.2 kW and a pulse length less than 200 ns;
  - c. Pulsed excimer "lasers" ( $\text{XeF}$ ,  $\text{XeCl}$ ,  $\text{KrF}$ ) with a repetition rate of more than 250 Hz and an average power of more than 250 W;  
(For the embargo status of "lasers", see Category 1061.5.)
3. The following microwave power sources and "superconductive" electromagnets are important in the plasma separation process referred to in 3101.b.8.:
    - a. Microwave power sources of more than 30 GHz and more than 50 kW for ion production;
    - b. Solenoidal "superconductive" electromagnets of more than 30 cm inner diameter, with a magnetic field of more than 2 T and uniform to better than 1% over the central 80% of the inner volume;  
(For the embargo status of: Microwave power sources, see Category 1031.1.b.; "Superconductive" electromagnets, see Category 1031.1.e.3.)

### 3102. Plants for the reprocessing of irradiated nuclear reactor fuel elements, and specially designed or prepared equipment and components therefor, including:

- a. Fuel element chopping or shredding machines, i.e. remotely operated equipment to cut, chop, shred or shear irradiated nuclear reactor fuel assemblies, bundles or rods;
- b. Criticality safe tanks (e.g. small diameter, annular or slab tanks) specially designed or prepared for the dissolution of irradiated nuclear reactor fuel, which are capable of withstanding hot, highly corrosive liquids, and which can be remotely loaded and maintained;
- c. Counter-current solvent extractors and ion-exchange processing equipment specially designed or prepared for use in a plant for the reprocessing of irradiated natural uranium, depleted uranium or "special fissile materials" and other fissile materials;
- d. Process control instrumentation specially designed or prepared for monitoring or controlling the reprocessing of irradiated source and "special fissile materials" and other fissile materials.

#### Technical Note:

A plant for the reprocessing of irradiated nuclear reactor fuel elements includes equipment and components which normally come into direct contact with and directly control the irradiated fuel and the major nuclear material and fission product processing streams.

#### Statement of Understanding

Counter-current solvent extractors specially designed for use with nuclear propulsion equipment are embargoed by 3202. Certain other counter-current solvent extractors are embargoed by 3101.b.

### 3103. Nuclear reactors, i.e. reactors capable of operation so as to maintain a controlled, self-sustaining fission chain reaction, and equipment and components specially designed or prepared for use in connection with a nuclear reactor, including:

- a. Pressure vessels, i.e. metal vessels as complete units or as major shop-fabricated parts therefor, which are specially designed or prepared to contain the core of a nuclear reactor and 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, i.e. rods specially designed or prepared for the control of the reaction rate in a nuclear reactor, including the neutron absorbing part 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 to determine neutron flux levels;
- e. Pressure tubes, i.e. tubes specially designed or prepared to contain fuel elements and the primary coolant in a nuclear reactor at an operating pressure in excess of 50 bars (atmospheres);
- f. Coolant pumps, i.e. pumps specially designed or prepared for circulating the primary coolant of nuclear reactors;

- g. Internal components specially designed or prepared for the operation of a nuclear reactor, including core support structures, thermal shields, baffles, core grid plates and diffuser plates;
- h. Heat exchangers.

**Note:**

Each Government will use its discretion in determining whether or not a component is specially designed or prepared for use in connection with a nuclear reactor.

**3104. Plants specially designed for the fabrication of nuclear reactor fuel elements and specially designed equipment therefor.**

**Technical Note:**

A plant for the fabrication of nuclear reactor fuel elements includes equipment which:

- 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.

**3105. Plants for the production of heavy water, deuterium or deuterium compounds, and specially designed or prepared equipment and components therefor, as follows:**

- a. Plants for the production of heavy water, deuterium or deuterium compounds, as follows:
  - 1. Hydrogen sulphide-water exchange plants;
  - 2. Ammonia-hydrogen exchange plants;
  - 3. Hydrogen distillation plants;
- b. Equipment and components, as follows, specially designed or prepared for:
  - 1. Hydrogen sulphide-water exchange process:
    - a. Tray exchange towers;
    - b. Hydrogen sulphide gas compressors;
  - 2. Ammonia-hydrogen exchange process:
    - a. High-pressure ammonia-hydrogen exchange towers;
    - b. High-efficiency stage contactors;
    - c. Submersible stage recirculation pumps;
    - d. Ammonia crackers designed for pressures of more than  $3 \times 10^6$  pascal (30 bar);
  - 3. Hydrogen distillation process:
    - a. Hydrogen cryogenic distillation towers and cold boxes designed for operation below 35 K;
    - b. Turboexpanders or turboexpander-compressor sets designed for operation below 35 K;
  - 4. Concentration of heavy water to reactor grade (99.75 weight percent (o/w) deuterium oxide):
    - a. Water distillation towers containing specially designed packings;
    - b. Ammonia distillation towers containing specially designed packings;
    - c. Catalytic burners for conversion of fully enriched deuterium to heavy water;
    - d. Infrared absorption analysers capable of on-line hydrogen-deuterium ratio analysis where deuterium concentrations are equal to or more than 90 weight percent (o/w).

**3106. Plants for the production of uranium hexafluoride (UF<sub>6</sub>) and specially designed or prepared equipment and components therefor, as follows:**

- a. Plants for the production of UF<sub>6</sub> ;
- b. Equipment and components, as follows, specially designed or prepared for UF<sub>6</sub> production:
  - 1. Fluorination and hydrofluorination screw and fluid bed reactors and flame towers;
  - 2. Distillation equipment for the purification of UF<sub>6</sub>.

## C. Nuclear-related Equipment

**3201. Neutron generator systems, including tubes, designed for operation without an external vacuum system and using electrostatic acceleration to induce a tritium-deuterium nuclear reaction and specially designed components therefor.**

**3202. Power generating or propulsion equipment specially designed for use with military, space, marine or mobile nuclear reactors.**

**Notes:**

- 1. 3202. does not embargo conventional power generating equipment which, although designed for use in a particular nuclear station, could in principle be used in conjunction with conventional systems.
- 2. Each Government will use its discretion in determining whether or not power generating or propulsion equipment is specially designed for military, space, marine or mobile use.

**3203. Electrolytic cells for the production of fluorine with a production capacity exceeding 250 g of fluorine per hour.**

**3204. Equipment, as follows, specially designed or prepared for the separation of isotopes of lithium:**

- a. Packed liquid-liquid exchange columns specially designed for lithium amalgams;
- b. Amalgam pumps;
- c. Amalgam electrolysis cells;
- d. Evaporators for concentrated lithium hydroxide solution.

**3205. Equipment specially designed for the production or recovery of tritium.**

**3206. Equipment for nuclear reactors:**

- a. Simulators specially designed for nuclear reactors;
- b. Ultrasonic or eddy current test equipment specially designed for nuclear reactors.

## D. "Software"

**3301. "Software" specially designed or modified for the "development", "production" or "use" of equipment or materials embargoed by this List.**

# Definitions of Terms Used in the International Lists, Groups 1, 2 and 3

## "Accuracy"

(Usually measured in terms of inaccuracy) is the maximum deviation, positive or negative, of an indicated value from an accepted standard or true value.

## "Active flight control systems"

Function to prevent undesirable "aircraft" and missile motions or structural loads by autonomously processing outputs from multiple sensors and then providing necessary preventive commands to effect automatic control.

## "Active pixel"

A minimum (single) element of the solid state array which has a photoelectric transfer function when exposed to light (electromagnetic) radiation.

## "Adapted for use in war"

Any modification or selection (such as altering purity, shelf life, virulence, dissemination characteristics, or resistance to UV radiation) designed to increase the effectiveness in producing casualties in men or animals, degrading equipment or damaging crops or the environment.

## "Adaptive control"

A control system that adjusts the response from conditions detected during the operation (Reference: ISO 2806-1980).

## "Additives"

Substances used in explosive formulations to improve their properties.

## "Aircraft"

A fixed wing, swivel wing, rotary wing (helicopter), tilt rotor or tilt-wing airborne vehicle. (See also "civil aircraft")

## "Angular position deviation"

The maximum difference between angular position and the actual, very accurately measured angular position after the workpiece mount of the table has been turned out of its initial position. (Reference: VDI/VDE 2617, Draft: 'Rotary tables on coordinate measuring machines'.)

## "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.

### N.B.

1. "Circuit element": a single active or passive functional part of an electronic circuit, such as one diode, one transistor, one resistor, one capacitor, etc.
2. "Discrete component": a separately packaged "circuit element" with its own external connections.

## "Asynchronous transfer mode" ("ATM")

A transfer mode in which the information is organised into cells; it is asynchronous in the sense that the recurrence of cells depends on the required or instantaneous bit rate. (CCITT Recommendation L.113)

## "ATM" - see "Asynchronous transfer mode"

## "Automatic target tracking"

A processing technique that automatically determines and provides as output an extrapolated value of the most probable position of the target in real time.

## "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.

## "Basic gate propagation delay time"

The propagation delay time value corresponding to the basic gate used 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 the input/output delay time of a complex "monolithic integrated circuit".

## "Basic scientific research"

Experimental or theoretical work undertaken principally to acquire new knowledge of the fundamental principles of phenomena or observable facts, not primarily directed towards a specific practical aim or objective.

## "Beat length"

The distance over which two orthogonally polarised signals, initially in phase, must pass in order to achieve a 2 Pi radian(s) phase difference.

## "Bias" (accelerometer)

An accelerometer output when no acceleration is applied.

## "Biocatalysts"

"Enzymes" or other biological compounds which bind to and accelerate the degradation of CW agents.

### N.B.

"Enzymes": "biocatalysts" for specific chemical or biochemical reactions.

## "Biopolymers"

Biological macromolecules as follows:

- a. "Enzymes";
- b. Antibodies, "monoclonal", "polyclonal" or "anti-idiotypic";
- c. Specially designed or specially processed "receptors";

### N.B.

1. "Enzymes": "Biocatalysts" for specific chemical or biochemical reactions;
2. "Anti-idiotypic antibodies": Antibodies which bind to the specific antigen binding sites of other antibodies;
3. "Monoclonal antibodies": Proteins which bind to one antigenic site and are produced by a single clone of cells;
4. "Polyclonal antibodies": A mixture of proteins which bind to the specific antigen and are produced by more than one clone of cells;
5. "Receptors": Biological macromolecular structures capable of binding ligands, the binding of which affects physiological functions.

## "Camming" (axial displacement)

Axial displacement in one revolution of the main spindle measured in a plane perpendicular to the spindle faceplate, at a point next to the circumference of the spindle faceplate (Reference: ISO 230/1 1986, paragraph 5.63).

## "CE" - see "computing element"

## "Chemical Laser"

A "laser" in which the excited species is produced by the output energy from a chemical reaction.

## "Circulation-controlled anti-torque or circulation-controlled direction control systems"

Use air blown over aerodynamic surfaces to increase or control the forces generated by the surfaces.

## "Civil aircraft"

Those "aircraft" 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. (See also "aircraft")

## "Commingled"

Filament to filament blending of thermoplastic fibres and reinforcement fibres in order to produce a fibre reinforcement "matrix" mix in total fibre form.

## "Comminution"

A process to reduce a material to particles by crushing or grinding.

## "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.

## "Communications channel controller"

The physical interface which controls the flow of synchronous or asynchronous digital information. It is an assembly that can be integrated into computer or telecommunications equipment to provide communications access.

## "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.

## "Composite theoretical performance" ("CTP")

A measure of computational performance given in millions of theoretical operations per second (Mtops), calculated using the aggregation of "computing elements" ("CE"). (See Category 1040, Technical Note.)

## "Compound rotary table"

A table allowing the workpiece to rotate and tilt about two non-parallel axes, which can be coordinated simultaneously for "contouring control".

## "Computer using facility"

The end-user's 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 m in any direction from the centre of the "computer operating area".

### N.B.

"Computer operating area": the immediate contiguous and accessible area around the electronic computer, where the normal operating, support and service functions take place.

## "Computing element" ("CE")

The smallest computational unit that produces an arithmetic or logic result.

"Contouring control"

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 - 1980).

"Conventional unguided projectiles"

Are those which do not incorporate:

- a. Directional warheads, including warheads employing multi-point initiation to achieve focused blast/fragmentation characteristics;
- b. Sub-munitions or sub-munition capacity;
- c. Fuel/air explosives;
- d. Provisions for increasing the range or impact velocity;
- e. Kinetic energy armour penetration capability;
- f. Mid-flight guidance;
- g. Terminal guidance.

"Critical temperature"

(sometimes referred to as the transition temperature) of a specific "superconductive" material is the temperature at which the material loses all resistance to the flow of direct electrical current.

"Cryptography"

The discipline which embodies principles, means and methods for the transformation of data in order to hide its information content, prevent its undetected modification or prevent its unauthorized use. "Cryptography" is limited to the transformation of information using one or more "secret parameters" (e.g. crypto variables) or associated key management.

**N.B.**

"Secret parameter": a constant or key kept from the knowledge of others or shared only within a group.

"CTP" - see "Composite theoretical performance"

"Datagram"

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 this source or destination data terminal equipment and the transporting network.

"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. Bits for coding, checking and synchronisation functions are to be included.

**N.B.**

1. When determining the "data signalling rate", servicing and administrative channels shall be excluded.
2. It is the maximum one-way rate, i.e. the maximum rate in either transmission or reception.

"Deformable Mirrors"

Mirrors:

- a. Having a single continuous optical reflecting surface which is dynamically deformed by the application of individual torques or forces to compensate for distortions in the optical waveform incident upon the mirror; or
- b. Having multiple optical reflecting elements that can be individually and dynamically repositioned by the application of torques or forces to compensate for distortions in the optical waveform incident upon the mirror.

Deformable mirrors are also known as adaptive optic mirrors.

"Development"

Is related to all stages prior to serial production, such as: design, design research, design analyzes, design concepts, assembly and testing of prototypes, pilot production schemes, design data, process of transforming design data into a product, configuration design, integration design, layouts.

"Diffusion bonding"

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.

"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.

"Digital transfer rate"

The total bit rate of the information that is directly transferred on any type of medium. (See also "total digital transfer rate").

"Drift rate" (gyro)

The time rate of output deviation from the desired output. It consists of random and systematic components and is expressed as an equivalent input angular displacement per unit time with respect to inertial space.

"Dynamic adaptive routing"

Automatic rerouting of traffic based on sensing and analysis of current actual network conditions.

**N.B.**

This does not include cases of routing decisions taken on predefined information.

"Dynamic signal analyzers"

"Signal analyzers" which use digital sampling and transformation techniques to form a Fourier spectrum display of the given waveform including amplitude and phase information. (See also "signal analyzers")

"Effective gramme"

Of special or other fissile material is defined as follows:

- a. For plutonium isotopes and uranium-233, the isotope weight in grammes;
- b. For uranium enriched 1% or more in the isotope U-235, the element weight in grammes multiplied by the square of its enrichment expressed as a decimal weight fraction;
- c. For uranium enriched below 1% in the isotope U-235, the element weight in grammes multiplied by 0.0001;
- d. For americium-242m, curium-245 and -247 and californium -249 and -251, the isotope weight in grammes multiplied by 10.

"Electronically steerable phased array antenna"

An antenna which forms a beam by means of phase coupling, i.e. the beam direction is controlled by the complex excitation coefficients of the radiating elements and the direction of that beam can be varied in azimuth or in elevation, or both, by application, both in transmission and reception, of an electrical signal.

"End-effectors"

"End-effectors" include grippers, "active tooling units" and any other tooling that is attached to the baseplate on the end of a "robot" manipulator arm.

**N.B.**

Active tooling unit: a device for applying motive power, process energy or sensing to the workpiece.

"Equivalent Density"

The mass of an optic per unit optical area projected onto the optical surface.

"Expert systems"

Systems providing results by application of rules to data which are stored independently of the "programme" and capable of any of the following:

- a. Modifying automatically the "source code" introduced by the user;
- b. Providing knowledge linked to a class of problems in quasi-natural language; **or**
- c. Acquiring the knowledge required for their development (symbolic training).

"Expression Vectors"

Carriers (e.g. plasmid or virus) used to introduce genetic material into host cells.

"Family"

Consists of microprocessor or microcomputer microcircuits with:

- a. The same architecture;
- b. The same basic instruction set; **and**
- c. The same basic technology (e.g. only NMOS or only CMOS).

"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.

**N.B.** "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.

"Fault tolerance"

The capability of a computer system, after any malfunction of any of its hardware or "software" components, to continue to operate without human intervention, at a given level of service that provides continuity of operation, data integrity and recovery of service within a given time.

"Fibrous or filamentary materials"

Include:

- 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;
- f. Aromatic polyamide pulp.

"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".

**N.B.**

"Circuit element": a single active or passive functional part of an electronic circuit, such as one diode, one transistor, one resistor, one capacitor, etc.

"Fixed"

The coding or compression algorithm cannot accept externally supplied parameters (e.g. cryptographic or key variables) and cannot be modified by the user.

"Flexible manufacturing unit" ("FMU"),

(sometimes also referred to as flexible manufacturing system (FMS) or flexible manufacturing cell (FMC))

An entity which includes a combination of at least:

- a. A "digital computer" including its own "main storage" and its own related equipment; **and**
- b. Two or more of the following:
  1. A machine tool described in 1022.1.c.;
  2. A dimensional inspection machine described in 1020., or another digitally controlled measuring machine embargoed by 1020.;
  3. A "robot" embargoed by 1020., 1080. or Item 2017 on the Munitions List;
  4. Digitally controlled equipment embargoed by 1012.3., 1022.3. or 1092.1.;
  5. "Stored programme controlled" equipment embargoed by 1032.1.a.;
  6. Digitally controlled equipment embargoed by 1012.1.;
  7. Digitally controlled electronic equipment embargoed by 1031.2.c.

"Fluoride fibres"

Fibres manufactured from bulk fluoride compounds.

"FMU" - see "Flexible manufacturing unit"

"Focal plane array"

A linear or two-dimensional planar layer, or combination of planar layers, of individual detector elements, with or without readout electronics, which work in the focal plane.

**N.B.**

This definition does not include a stack of single detector elements or any two, three or four element detectors provided time delay and integration is not performed within the element.

"Frequency agility" (frequency hopping)

A form of "spread spectrum" in which the transmission frequency of a single communication channel is made to change by discrete steps.

"Frequency agility" (radar) - see "Radar frequency agility"

"Frequency switching time"

The maximum time (i.e. delay), taken by a signal, 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.

"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.

"Gas Atomisation"

A process to reduce a molten stream of metal alloy to droplets of 500 µm diameter or less by a high pressure gas stream.

"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.

"Generic software"

A set of instructions for a "stored programme controlled" switching system that is the same for all switches using that type of switching system.

**N.B.**

The data base portion is not considered to be part of the "generic software".

"Geographically dispersed"

Sensors are considered "geographically dispersed" when each location is distant from any other more than 1,500 m in any direction. Mobile sensors are always considered "geographically dispersed".

"Global interrupt latency time"

The time taken by the computer system to recognize an interrupt due to the event, service the interrupt and perform a context switch to an alternate memory-resident task waiting on the interrupt.

"Hot isostatic densification"

A process of pressurising a casting at temperatures exceeding 375 K (102°C) 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.

"Hybrid computer"

Equipment which can:

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

"Hybrid integrated circuit"

Any combination of integrated circuit(s), or integrated circuit with "circuit elements" or "discrete components" connected together to perform (a) specific function(s), and having all of the following characteristics:

- a. Containing at least one unencapsulated device;
- b. Connected together using typical IC production methods;
- c. Replaceable as an entity; **and**
- d. Not normally capable of being disassembled.

**N.B.**

1. "Circuit element": a single active or passive functional part of an electronic circuit, such as one diode, one transistor, one resistor, one capacitor, etc.
2. "Discrete component": a separately packaged "circuit element" with its own external connections.

"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.

"Information security"

All the means and functions ensuring the accessibility, confidentiality or integrity of information or communications, excluding the means and functions intended to safeguard against malfunctions. This includes "cryptography", "cryptanalysis", protection against compromising emanations and computer security.

**N.B.**

"Cryptanalysis": the analysis of a cryptographic system or its inputs and outputs to derive confidential variables or sensitive data, including clear text. (ISO 7498-2-1988 (E), paragraph 3.3.18)

"Instantaneous bandwidth"

The bandwidth over which output power remains constant within 3 dB without adjustment of other operating parameters.

"Instrumented range"

The specified unambiguous display range of a radar.

"Integrated Services Digital Network" ("ISDN")

A unified end-to-end digital network, in which data originating from all types of communication (e.g. voice, text, data, still and moving pictures) are transmitted from one port (terminal) in the exchange (switch) over one access line to and from the subscriber.

"Interconnected radar sensors"

Two or more radar sensors are interconnected when they mutually exchange data in real time.

"In the public domain"

As it applies to the International Lists, means "technology" or "software" which has been made available without restrictions upon its further dissemination.

**N.B.**

Copyright restrictions do not remove "technology" or "software" from being "in the public domain".

"Intrinsic Magnetic Gradiometer"

A single magnetic field gradient sensing element and associated electronics the output of which is a measure of magnetic field gradient. (See also "Magnetic Gradiometer")

"ISDN" - see "Integrated Services Digital Network"

"Isostatic presses"

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.

"Laser" - see "Chemical laser", "Laser", "Q-switched laser", "Super High Power Laser", and "Transfer laser".

"Laser"

An assembly of components which produce both spatially and temporally coherent light that is amplified by stimulated emission of radiation.

"Linearity"

(Usually measured in terms of non-linearity) is 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.

"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).

**N.B.**

"Data device": equipment capable of transmitting or receiving sequences of digital information.

"Magnetic Gradiometers"

Are designed to detect the spatial variation of magnetic fields from sources external to the instrument. They consist of multiple "magnetometers" and associated electronics the output of which is a measure of magnetic field gradient. (See also "Intrinsic Magnetic Gradiometer")

"Magnetometers"

Are designed to detect magnetic fields from sources external to the instrument. They consist of a single magnetic field sensing element and associated electronics the output of which is a measure of the magnetic field.

"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.

"Matrix"

A substantially continuous phase that fills the space between particles, whiskers or fibres.

"Maximum Bit Transfer Rate" ("MBTR")

Of solid state storage equipment: the number of data bits per second transferred between the equipment and its controller.

Of a disk drive: the internal data transfer rate calculated as follows:

"MBTR" (bits per second) =  $B \times R \times T$

where:

B = Maximum number of data bits per track available to read or write in a single revolution;

R = revolutions per second;

T = Number of tracks which can be read or written simultaneously.

"MBTR" - see "Maximum Bit Transfer Rate"

"Measurement uncertainty"

The characteristic parameter which specifies in what range around the output value the correct value of the measurable variable lies with a confidence level of 95%. It includes the uncorrected systematic deviations, the uncorrected backlash and the random deviations (Reference: VDI/VDE 2617).

"Mechanical Alloying"

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

"Media access unit"

Equipment which contains one or more communication interfaces ("network access controller", "communications channel controller", modem or computer bus) to connect terminal equipment to a network.

"Melt Extraction"

A process to "solidify rapidly" and extract a ribbon-like alloy product by the insertion of a short segment of a rotating chilled block into a bath of a molten metal alloy.

**N.B.**

"Solidify rapidly": solidification of molten material at cooling rates exceeding 1,000 K/sec.

"Melt Spinning"

A process to "solidify rapidly" a molten metal stream impinging upon a rotating chilled block, forming a flake, ribbon or rod-like product.

**N.B.**

"Solidify rapidly": solidification of molten material at cooling rates exceeding 1,000 K/sec.

"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.**

1. 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.
2. This definition includes chip sets which are designed to operate together to provide the function of a "microprocessor microcircuit".

"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.

"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.

**N.B.**

"Circuit element": a single active or passive functional part of an electronic circuit, such as one diode, one transistor, one resistor, one capacitor, etc.

"Motion control board"

An electronic "assembly" specially designed to provide a computer system with the capability to coordinate simultaneously the motion of axes of machine tools for "contouring control".

"Multichip integrated circuit"

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

"Multi-data-stream processing"

The "microprogramme" or equipment architecture technique which permits simultaneous processing of two or more data sequences under the control of one or more instruction sequences by means such as:

- a. Single Instruction Multiple Data (SIMD) architectures such as vector or array processors;
- b. Multiple Single Instruction Multiple Data (MSIMD) architectures;
- c. Multiple Instruction Multiple Data (MIMD) architectures, including those which are tightly coupled, closely coupled or loosely coupled; **or**
- d. Structured arrays of processing elements, including systolic arrays.

"Multilevel security"

A class of system containing information with different sensitivities that simultaneously permits access by users with different security clearances and needs-to-know, but prevents users from obtaining access to information for which they lack authorization.

**N.B.**

"Multilevel security" is computer security and not computer reliability which deals with equipment fault prevention or human error prevention in general.

"Multispectral imaging sensors"

Are capable of simultaneous or serial acquisition of imaging data from two or more discrete spectral bands. Sensors having more than twenty discrete spectral bands are sometimes referred to as hyperspectral imaging sensors.

"Network access controller"

A physical interface to a distributed switching network. It uses a common medium which operates throughout at the same "digital transfer rate" using arbitration (e.g. token or carrier sense) for transmission. Independently from any other, it selects data packets or data groups (e.g. IEEE 802) addressed to it. It is an assembly that can be integrated into computer or telecommunications equipment to provide communications access.

"Neural computer"

A computational device designed or modified to mimic the behaviour of a neuron or a collection of neurons, i.e. a computational device which is distinguished by its hardware capability to modulate the weights and numbers of the interconnections of a multiplicity of computational components based on previous data.

"Noise level"

An electrical signal given in terms of power spectral density. The relation between "noise level" expressed in peak-to-peak is given by  $S^2_{pp} = 8N_0(f_2-f_1)$ , where  $S_{pp}$  is the peak-to-peak value of the signal (e.g. nanoteslas),  $N_0$  is the power spectral density (e.g. (nanotesla)<sup>2</sup>/Hz) and  $(f_2-f_1)$  defines the bandwidth of interest.

"Nuclear reactor"

Includes the items within or attached directly to the reactor vessel, the equipment which controls the level of power in the core, and the components which normally contain or come into direct contact with or control the primary coolant of the reactor core.

"Numerical control"

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).

"Object code" (or object language)

"Object code" (or object language): An equipment executable form of a convenient expression of one or more processes ("source code" (or source language)) which has been converted by a programming system.

"Optical amplification"

In optical communications, an amplification technique that introduces a gain of optical signals that have been generated by a separate optical source, without conversion to electrical signals, i.e. using semiconductor optical amplifiers, optical fibre luminescent amplifiers.

"Optical computer"

A computer designed or modified to use light to represent data and whose computational logic elements are based on directly coupled optical devices.

"Optical fibre preforms"

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.

"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).

"Optical switching"

The routing of or switching of signals in optical form without conversion to electrical signals.

"Other fissile material"

"Previously separated" americium-242m, curium-245 and -247, californium-249 and -251, isotopes of plutonium other than plutonium-238 and -239, and any material containing the foregoing.

"Overall current density"

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.).

"PABX" - see "Private automatic branch exchange".

"Peak power"

Energy per pulse in joules divided by the pulse duration in seconds.

"Personalized smart card"

A smart card containing a microcircuit, in accordance with ISO/IEC 7816, which has been programmed by the issuer and cannot be changed by the user.

"Power management"

Changing the transmitted power of the altimeter signal so that received power at the "aircraft" altitude is always at the minimum necessary to determine the altitude.

"Precursors"

Specialty chemicals used in the manufacture of military explosives.

"Previously separated"

The application of any process intended to increase the concentration of the controlled isotope.

"Principal element"

An element is a "principal element" when its replacement value is more than 35% of the total value of the system of which it is an element. Element value is the price paid for the element by the manufacturer of the system, or by the system integrator. Total value is the normal international selling price to unrelated parties at the point of manufacture or consolidation of shipment.

"Private automatic branch exchange" ("PABX")

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.

"Production"

Includes design, examination, manufacture, testing and checking.

"Production"

Means all production stages, such as: product engineering, manufacture, integration, assembly (mounting), inspection, testing, quality assurance.

"Programme"

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

"Pulse compression"

The coding and processing of a radar signal pulse of long time duration to one of short time duration, while maintaining the benefits of high pulse energy.

"Pulse duration"

Duration of a "laser" pulse measured at Full Width Half Intensity (FWHI) levels.

"Q-switched laser"

A "laser" in which the energy is stored in the population inversion or in the optical resonator and subsequently emitted in a pulse.

"Radar frequency agility"

Any technique which changes, in a pseudo-random sequence, the carrier frequency of a pulsed radar transmitter between pulses or between groups of pulses by an amount equal to or larger than the pulse bandwidth.

"Radar spread spectrum"

Any modulation technique for spreading energy originating from a signal with a relatively narrow frequency band, over a much wider band of frequencies, by using random or pseudo-random coding.

"Real time bandwidth"

For "dynamic signal analyzers", the widest frequency range which the analyzer can output to display or mass storage without causing any discontinuity in the analysis of the input data. For analyzers with more than one channel, the channel configuration yielding the widest "real-time bandwidth" shall be used to make the calculation.

"Real time processing"

The processing of data by a computer system providing a required level of service, as a function of available resources, within a guaranteed response time, regardless of the load of the system, when stimulated by an external event.

"Required"

As applied to "technology", refers to only that portion of "technology" which is peculiarly responsible for achieving or exceeding the embargoed performance levels, characteristics or functions. Such "required" "technology" may be shared by different products.

"Resolution"

The least increment of a measuring device; on digital instruments, the least significant bit. (Reference: ANSI B-89.1.12)

"Riot control agents"

Substances which produce temporary irritating or disabling physical effects which disappear within minutes of removal from exposure. There is no significant risk of permanent injury and medical treatment is rarely required.

"Robot"

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:

- a. Is multifunctional;
- b. Is capable of positioning or orienting material, parts, tools or special devices through variable movements in three dimensional space;
- c. Incorporates three or more closed or open loop servo-devices which may include stepping motors; **and**
- d. Has "user-accessible programmability" by means of the 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. *Stacker cranes 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.*

"Rotary Atomization"

A process to reduce a stream or pool of molten metal to droplets to a diameter of 500 µm or less by centrifugal force.

"Run out" (out-of-true running)

Radial displacement in one revolution of the main spindle measured in a plane perpendicular to the spindle axis at a point on the external or internal revolving surface to be tested (Reference: ISO 230/1-1986, paragraph 5.61).

"Scale factor" (gyro or accelerometer)

The ratio of change in output to a change in the input intended to be measured. Scale factor is generally evaluated as the slope of the straight line that can be fitted by the method of least squares to input-output data obtained by varying the input cyclically over the input range.

"SDH" - see "Synchronous digital hierarchy"

"Settling time"

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.

"SHPL" - see "Super High Power Laser"

"Signal analyzers"

Apparatus capable of measuring and displaying basic properties of the single-frequency components of multi-frequency signals.

"Signal analyzers" (dynamic) - see "Dynamic signal analyzers"

"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).

"Simple educational devices"

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

"Software"

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

"SONET" - see "Synchronous optical network"

"Source code" (or source language)

A convenient expression of one or more processes which may be turned by a programming system into equipment executable form ("object code" (or object language)).

"Spacecraft"

Active and passive satellites and space probes.

"Space qualified"

Products designed, manufactured and tested to meet the special electrical, mechanical or environmental requirements for use in the launch and deployment of satellites or high altitude flight systems operating at altitudes of 100 km or higher.

"Special fissile material"

Plutonium-239, uranium-233, uranium enriched in the isotopes 235 or 233, and any material containing the foregoing.

"Spectral efficiency"

A figure of merit parametrized to characterize the efficiency of transmission system which uses complex modulation schemes such as QAM, Trellis coding, QSPK (Q-phased shift key), etc. It is defined as follows:

$$\text{"Spectral efficiency"} = \frac{\text{"Digital transfer rate"}(\text{bits/second})}{6 \text{ dB spectrum bandwidth (Hz)}}$$

"Splat Quenching"

A process to "solidify rapidly" a molten metal stream impinging upon a chilled block, forming a flake-like product.

**N.B.**

"Solidify rapidly": solidification of molten material at cooling rates exceeding 1,000 K/sec.

"Spread spectrum"

The technique whereby energy in a relatively narrow-band communication channel is spread over a much wider energy spectrum.

"Spread spectrum" radar - see "Radar spread spectrum"

"Sputtering"

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 of the process.

"Stability"

Standard deviation (1 sigma) of the variation of a particular parameter from its calibrated value measured under stable temperature conditions. This can be expressed as a function of time.

"Stored programme controlled"

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.

"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.

**N.B.**

"Discrete component": a separately packaged "circuit element" with its own external connections.

"Substrate blanks"

Monolithic compounds with dimensions suitable for the production of optical elements such as mirrors or optical windows.

"Superalloys"

Nickel-, cobalt- or iron-base alloys having strengths superior to any alloys in the AISI 300 series at temperatures over 922 K (649°C) under severe environmental and operating conditions.

"Superconductive"

Refers to 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.

"Super High Power Laser" ("SHPL")

A "laser" capable of delivering (the total or any portion of) the output energy exceeding 1 kJ within 50 ms or having an average or CW power exceeding 20 kW.

"Superplastic forming"

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.

"Swept frequency network analyzers"

Involve the automatic measurement of equivalent circuit parameters over a range of frequencies, involving swept frequency measurement techniques but not continuous wave point-to-point measurements.

"Switch fabric"

That hardware and associated "software" which provides the physical or virtual connection path for in-transit message traffic being switched.

"Synchronous digital hierarchy" ("SDH")

A digital hierarchy providing a means to manage, multiplex and access various forms of digital traffic using a synchronous transmission format on different types of media. The format is based on the Synchronous Transport Module (STM) which is defined by CCITT Recommendation G.703, G.707, G.708, G.709 and others yet to be published. The first level rate of "SDH" is 155.52 Mbit/s.

"Synchronous optical network" ("SONET")

A network providing a means to manage, multiplex and access various forms of digital traffic using a synchronous transmission format on fibre optics. The format is the North America version of "SDH" and also uses the Synchronous Transport Module (STM). However, it uses the Synchronous Transport Signal (STS) as the basic transport module with a first level rate of 51.81 Mbit/s. (The "SONET" standards are being integrated into those of "SDH").

"Systems tracks"

Processed, correlated (fusion of radar target data to flight plan position) and updated aircraft flight position report available to the Air Traffic Control centre controllers.

"Systolic array computer"

A computer where the flow and modification of the data is dynamically controllable at the logic gate level by the user.

"Tear gases"

Gases which produce temporary irritating or disabling effects which disappear within minutes of removal from exposure.

"Technology"

Specific information necessary for the "development", "production" or "use" of a product. The information takes the form of "technical data" or "technical assistance". Embargoed "technology" is defined in the General Technology Note and in the International Industrial List.

**N.B.**

1. "Technical data" may take forms such as blueprints, plans, diagrams, models, formulae, tables, engineering designs and specifications, manuals and instructions written or recorded on other media or devices such as disk, tape, read-only memories.
2. "Technical assistance" may take forms such as instruction, skills, training, working knowledge, consulting services. "Technical assistance" may involve transfer of "technical data".

"Terminal interface equipment"

Equipment at which information enters or leaves the telecommunication system, e.g. telephone, data device, computer, facsimile device.

"Three dimensional Vector Rate"

The number of vectors generated per second which have 10 pixel poly line vectors, clip tested, randomly oriented, with either integer or floating point X-Y-Z coordinate values (whichever produces the maximum rate).

"Tilting spindle"

A tool-holding spindle which alters, during the machining process, the angular position of its centre line with respect to any other axis.

"Time constant"

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).

"Total digital transfer rate"

The number of bits, including line coding, overhead and so forth per unit time passing between corresponding equipment in a digital transmission system. (See also "digital transfer rate")

"Transfer laser"

A "laser" in which the lasing species is excited through the transfer of energy by collision of a non-lasing atom or molecule with a lasing atom or molecule species.

"Tunable"

The ability of a "laser" to produce a continuous output at all wavelengths over a range of several "laser" transitions. A line selectable "laser" produces discrete wavelengths within one "laser" transition and is not considered "tunable".

"Two dimensional Vector Rate"

The number of vectors generated per second which have 10 pixel poly line vectors, clip tested, randomly oriented, with either integer or floating point X-Y coordinate values (whichever produces the maximum rate).

"Use"

Operation, installation (including on-site installation), maintenance (checking), repair, overhaul and refurbishing.

"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.

"Vacuum Atomization"

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

"Variable geometry airfoils"

Use trailing edge flaps or tabs, or leading edge slats or pivoted nose droop, the position of which can be controlled in flight.

Vector Rate - See "Three dimensional Vector Rate".

## Group 4 – Nuclear Non-proliferation List

Definitions to the terms set out in quotations are listed in pages 49 to 55 of this Guide and apply in respect to Part I only of this Group.

The definitions set out in 65 and 66 of this Guide apply in respect to Group 4 – Part II only.

### 4000. Technology

1. **Part I – Technical data including, but not limited to, technical drawings, models, photographic negatives and prints, recordings, design data and technical and operating manuals whether in written form or recorded on other media or devices such as disk, tape and read-only memories for the design, production construction, operation or maintenance of any item in this Group, except data available to the public (e.g. in published books or periodicals, or that which has been made available without restrictions upon its further dissemination).**
2. **Part II – Technical data required for the "development", "production", or "use" of any item contained in the List, except data available to the public (e.g. in published books or periodicals, or that which has been made available without restrictions upon its further dissemination).**

### Part I – Atomic Energy Materials and Equipment

#### 4001. Special and Other Fissionable Materials

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 38 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.

#### 4002. Source Materials

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.

#### 4003. Deuterium

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.

#### 4004. Zirconium

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.

#### 4005. Nickel

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 99.9 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<sup>2</sup> in size intended for use in batteries for civil applications.

#### 4006. Nuclear-grade Graphite

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<sup>3</sup>.

#### 4012. Tritium

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.

#### 4013. Materials for Nuclear Heat Sources

1. In this item, "previously separated" has the same meaning as in item 4001. (*précédemment séparé*)
2. Materials for nuclear heat sources, that is, previously separated neptunium 237 in any form.

#### 4014. Especially Designed or Prepared Materials for Separation of Isotopes

Especially designed or prepared materials, including especially 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.

#### 4100. Parts for especially designed equipment included in Items 4101 to 4221.

#### 4101. Plants for the separation of isotopes of special and other fissionable materials and source materials and especially designed or prepared equipment and components therefor, including

- a. valves that are wholly made of or lined with UF<sub>6</sub>-resistant fully fluorinated hydrocarbon polymers, stainless steel, aluminum, aluminum alloys, aluminium oxide, nickel or alloys that contain 60 weight per cent or more nickel and that are 40 mm or greater in diameter and have bellows seals;
- b. blowers and compressors, turbo, centrifugal axial and positive displacement types, that are wholly made of or lined with UF<sub>6</sub>-resistant fully fluorinated hydrocarbon polymers, stainless steel, aluminium, aluminium alloys, aluminium oxide, nickel or alloys that contain 60 weight per cent or more nickel and that have a capacity of 1.3 m<sup>3</sup>/minute or greater, including compressor seals;
- c. gaseous diffusion barriers;
- d. gaseous diffuser housings;

- e. heat exchangers that are made of or lined with UF<sub>6</sub>-resistant fully fluorinated hydrocarbon polymers, aluminium, aluminium alloys, aluminium oxide, 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
  - 1. complete rotor assemblies,
  - 2. rotor tubes,
  - 3. rings or bellows that are especially designed or prepared to give localized support to the rotor tube or to join together a number of rotor tubes,
  - 4. baffles, in the form of disc-shaped components that are especially designed or prepared to be mounted inside a centrifuge rotor tube,
  - 5. top caps and bottom caps, in the form of disc-shaped components that are especially designed or prepared to fit the ends of rotor tubes,
  - 6. magnetic suspension bearings that consist of an annular magnet which is suspended within a housing that contains a damping medium,
  - 7. bearings and dampers that comprise a pivot and cup assembly which is mounted on a damper,
  - 8. molecular pumps that comprise cylinders that have internally machined or extruded helical grooves and internally machined bores,
  - 9. stators for high speed multiphase AC hysteresis or reluctance motors that are designed for operation
    - a. in a vacuum,
    - 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,
  - 10. 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**
  - 11. machine header piping systems used for handling uranium hexafluoride within the centrifuge cascades.

**4102. Plants for the processing of irradiated nuclear materials in order to isolate or recover fissionable materials and equipment and components especially designed or prepared therefor, including**

- 1. a. nuclear fuel chopping or shredding machines;
- b. chemical holding or storage vessels that
  - 1. are fabricated of low-carbon stainless steels, titanium, zirconium or any other material that is resistant to the corrosive effect of nitric acid,
  - 2. are designed for remote operation and maintenance and
  - 3. 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.

**4103. Nuclear Reactors**

- 1. In this item, "control rod" means a rod especially 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 especially 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.

**4104. Plants for the fabrication of fuel elements and equipment that is especially 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.

**4105. Plants for the production or concentration of heavy water, deuterium and deuterium compounds and equipment especially designed or prepared therefor, including**

- a. Exchange towers fabricated from fine carbon steel (such as ASTM A516) with diameters of 6 m (20 ft) to 9 m (30 ft), capable of operating at pressures greater than or equal to 2 MPa (300 psi) and with a corrosion allowance of 6 mm or greater, especially designed or prepared for heavy water production utilizing the water-hydrogen sulphide exchange process.
- b. Single stage, low head (i.e. 0.2 MPa or 30 psi) centrifugal blowers or compressors for hydrogen-sulphide gas circulation (i.e. gas containing more than 70% H<sub>2</sub>S) especially designed or prepared for heavy water production utilizing the water-hydrogen sulphide exchange process. These blowers or compressors have a throughput capacity greater than or equal to 56 m<sup>3</sup>/second (120,000 SCFM) while operating at pressures greater than or equal to 1.8 MPa (260 psi) suction and have seals designed for wet H<sub>2</sub>S service.
- c. Ammonia-hydrogen exchange towers greater than or equal to 35 m (114.3 ft) in height with diameters of 1.5 m (4.9 ft) to 2.5 m (8.2 ft) capable of operating at pressures greater than 15 MPa (2225 psi) especially designed or prepared for heavy water production utilizing the ammonia-hydrogen exchange process. These towers also have at least one flanged, axial opening of the same diameter as the cylindrical part through which the tower internals can be inserted or withdrawn.
- d. Tower internals and stage pumps especially designed or prepared for towers for heavy water production utilizing the ammonia-hydrogen exchange process. Tower internals include especially designed stage contractors which promote intimate gas/liquid contact. Stage pumps include especially designed submersible pumps for circulation of liquid ammonia within a contacting stage internal to the stage towers.
- e. Ammonia crackers with operating pressures greater than or equal to 3 MPa (450 psi) especially designed or prepared for heavy water production utilizing the ammonia-hydrogen exchange process.
- f. Infrared absorption analyzers capable of "on-line" hydrogen/deuterium ratio analysis where deuterium concentrations are equal to or greater than 90%.
- g. Catalytic burners for the conversion of enriched deuterium gas into heavy water especially designed or prepared for heavy water production utilizing the ammonia-hydrogen exchange process.

**4106. Plants and systems and especially 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.

**4201. Neutron generator systems. See 4508.1.**

**4202. Power-generating or propulsion equipment that is specially designed or prepared for use with military, space, marine or mobile nuclear reactors.**

**4203. 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.**

**4204. Equipment that is specially designed or prepared for the separation of isotopes of lithium.**

**4205. Plants for the production, recovery, extraction, concentration or handling of tritium and its compounds and mixtures and specially designed or prepared equipment therefor.**

**4206. Frequency changers, converters or inverters that are especially designed or prepared to supply motor stators for gas centrifuge enrichment and subassemblies and especially 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.

**4220. Mass spectrometers that are especially 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
  1. nickel-plated,
  2. constructed of nichrome or monel, or
  3. lined with nichrome or monel; and
- c. a collector system that is suitable for isotopic analysis.

**4221. Process control instrumentation that is especially designed or modified for monitoring or controlling the processing of irradiated source materials and special and other fissionable materials.**

**Part II – Nuclear-related Dual-use List**

**4501. Industrial equipment**

1. Spin-forming and flow-forming machines:
  - a. which can be equipped with "numerical control" units or a computer control; and
  - b. with two or more axes that can be coordinated simultaneously for "contouring control," and precision rotor-forming mandrels designed to form cylindrical rotors of inside diameter between 75 mm (3 in.) and 400 mm (16 in.) and specially designed software therefor.

**Note:**

Only spin-forming machines combining the function of spin-forming and flow-forming are included in Item 4501.1

2. "Numerical control" units, specially designed "motion control boards" for "numerical control" applications on machine tools, "numerically controlled" machine tools, specially designed "software," and technology as follows:
  - a. "Numerical control" units for machine tools, as follows:
    1. Having more than four interpolating axes that can be coordinated simultaneously for "contouring control" or
    2. Having two, three, or four interpolating axes that can be coordinated simultaneously for "contouring control" and one or more of the following conditions are fulfilled:
      - a. Capable of "real-time processing" of data to modify the tool path during the machining operation by automatic calculation and modification of "part program" data for machining in two or more axes by means of measuring cycles and access to source data;
      - b. Capable of receiving directly (on-line) and processing computer-aided design (CAD) data for internal preparation of machine instructions; or
      - c. Capable, without modification, according to the manufacturer's technical specifications, of accepting additional boards that would permit increasing the number of interpolating axes that can be coordinated simultaneously for "contouring control," above the control levels, even if they do not contain these additional boards.
  - b. "Motion control boards" specially designed for machine tools having one or more of the following characteristics:
    1. Providing interpolation in more than four axes;
    2. Capable of "real time processing" described in 4501.2.a.2.a; or
    3. Capable of receiving and processing CAD data as described in 4501.2.a.2.b. above.

**Notes:**

1. Subitems (a) and (b) do not include "numerical control" units and "motion control boards" if
  - a. Modified for and incorporated in uncontrolled machines; or
  - b. Specially designed for uncontrolled machines.
2. "Software" (including documentation) for "numerical control" units that may be exported must be:
  - a. In machine executable form only; and
  - b. Limited to the minimum necessary for the use (i.e. installation, operation and maintenance) of these units.

2. c. Machine tools, as follows, for removing or cutting metals, ceramics, or composites, which, according to the manufacturer's technical specifications, can be equipped with electronic devices for simultaneous "contouring control" in two or more axes:

**Technical Note:**

1. The c-axis on jig grinders used to maintain grinding wheels normal to the work surfaces is not considered a contouring rotary axis.
2. Not counted in the total number of contouring axes are secondary parallel contouring axes, e.g. a secondary rotary axis, the centre line of which is parallel to the primary rotary axis.
3. Axis nomenclature shall be in accordance with International Standard ISO 841, "Numerical Control Machines Axis and Motion Nomenclature."
4. Rotary axes do not necessarily have to rotate over 360°. A rotary axis can be driven by a linear device, e.g. a screw or a rack-and-pinion.

2. c. 1. Machine tools for turning, grinding, milling, or any combination thereof that:
  - a. Have two or more axes that can be coordinated simultaneously for "contouring control"; and
  - b. Have any of the following characteristics:
    1. Two or more contouring rotary axes;
    2. One or more contouring "tilting spindles:"

**Note:**

c.1.b.2. applies to machine tools for grinding or milling only.

3. "Cammings" (axial displacement) in one revolution of the spindle less (better) than 0.0006 mm total indicator reading (TIR);

**Note:**

c.1.b.3. applies to machine tools for turning only.

4501. cont'd.

- 2. c. 1. b. 4. "Run out" (out-of-true running) in one revolution of the spindle less (better) than 0.0006 TIR.
- 5. The "positioning accuracies," with all compensations available, are less (better) than:
  - a. 0.001° on any rotary axis
  - b. 1. 0.004 mm along any linear axis (overall positioning) for grinding machines
  - 2. 0.006 mm along any linear axis (overall positioning) for milling or turning machines

**Note:**

4501.2.c.1.b.5.b.2. does not control milling or turning machine tools with a positioning accuracy along one linear axis, with all compensations available, equal to or greater (worse) than 0.005 mm.

**Notes:**

- 1. Sub-item 4501.2.c. does not include cylindrical external, internal and external-internal grinding machines having **all** of the following characteristics:
  - a. Not centerless (shoe-type) grinding machines;
  - b. Limited to cylindrical grinding;
  - c. A maximum workpiece outside diameter or length of 150 mm;
  - d. Only two axes that can be coordinated simultaneously for "contouring control"; **and**
  - e. No contouring c axis.
- 2. Sub-item 4501.2.c. does not include machines designed specifically as jig grinders having both of the following characteristic:
  - a. Axes limited to x, y, c and a, where the c axis is used to maintain the grinding wheel normal to the work surface and the a axis is configured to grind barrel cams **and**
  - b. A spindle "run-out" not less (not better) than 0.006 mm.
- 3. Sub-item 4501.2.c. does not include tool or cutter grinding machines having **all** of the following characteristics:
  - a. Shipped as a complete system with "software" specially designed for the production of tools or cutters;
  - b. No more than two rotary axes that can be coordinated simultaneously for "contouring control";
  - c. "Run-out" (out-of-true running) in one revolution of the spindle not less (not better) than 0.0006 mm TIR; **and**
  - d. The "positioning accuracies," with all compensations available, are not less (not better) than:
    - 1. 0.004 mm along any linear axis for overall positioning; **or**
    - 2. 0.001° for any rotary axis.
- c. 2. Electrical discharge machines (EDM);
  - a. Of the wire feed type that have five or more axes that can be coordinated simultaneously for "contouring control";
  - b. Non-wire EDMs that have two or more contouring rotary axes and that can be coordinated simultaneously for "contouring control."
- 3. Other machine tools for removing metals, ceramics, or composites:
  - a. By means of:
    - 1. Water or other liquid jets, including those employing abrasive additives;
    - 2. Electron beam; **or**
    - 3. "Laser" beam; **and**
  - b. Having two or more rotary axes that:
    - 1. Can be coordinated simultaneously for "contouring control"; **and**
    - 2. Have a "positioning accuracy" of less (better) than 0.003°.
- d. 1. "Software"
  - a. "Software" especially designed or modified for the "development," "production," or "use" of equipment controlled by sub-categories 4501.2.a., b., or c. above;
  - b. Specific "software," as follows:
    - 1. "Software" to provide "adaptive control" and having both of the following characteristics:
      - 2. a. 1. For "flexible manufacturing units" (FMUs) that consist at least of equipment described in (b)(1) and(b)(2) of the definition of "flexible manufacturing units"; **and**

- 2. Capable of generating or modifying in "real time processing," "part program" data by using the signals obtained simultaneously by means of at least two detection techniques, such as:
  - a. Machine vision (optical ranging);
  - b. Infrared imaging;
  - c. Acoustical imaging (acoustical ranging);
  - d. Tactile measurement;
  - e. Inertial positioning;
  - f. Force measurement;
  - g. Torque measurement.

**Note:**

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

- d. 2. b. "Software" for electronic devices other than those described in sub-items 4501.2.a. or b. that provides the "numerical control" capability of the equipment controlled in sub-item 4501.2.
- e. Technology
  - 1. "Technology" for the "development" of equipment controlled by sub-items 4501.2.a., b., or c. above, 4501.2.f. or g. below and of the sub-item 4501.2.d.
  - 2. "Technology" for the "production" of equipment controlled by sub-items 4501.2.a., b., or c. above, 4501.2.f. or g. below;
  - 3. Other "technology":
    - a. For the "development" of interactive graphics as an integrated part in "numerical control" units for preparation or modification of "part programs";
    - b. For the "development" of integration "software" for incorporation of expert systems for advanced decision support of shop floor operations into "numerical control" units.
- f. Components and parts for machine tools controlled by sub-item 4501.2.c. as follows:
  - 1. Spindle assemblies, consisting of spindles and bearings as a minimal assembly, with radial ("run-out") or axial ("camming") axis motion in one revolution of the spindle less (better) than 0.0006 mm TIR;
  - 2. Linear position feedback units (e.g. inductive-type devices, graduated scales, "laser," or infrared systems) having with compensation, an overall "accuracy" better than  $800 + (600 \times L \times 10^{-3})$  nm, where L equals the effective length in millimetres of the linear measurement; except measuring interferometer systems, without closed or open loop feedback, containing a "laser" to measure slide movement errors of machine tools, dimensional inspection machines, or similar equipment;
  - 3. Rotary position feedback units (e.g. inductive-type devices, graduated scales, "laser," or infrared systems) having, with compensation, an "accuracy" less (better) than 0.0025° of arc; except measuring interferometer systems, without closed or open loop feedback, containing a "laser" to measure slide movement errors of machine tools, dimensional inspection machines, or similar equipment;
  - 4. Slide way assemblies consisting of a minimal assembly of ways, bed and slide having all of the following characteristics:
    - a. A yaw, pitch, or roll of less (better) than 2 seconds of arc TIR (Ref. ISO/DIS 230-1 over full travel);
    - b. A horizontal straightness of less (better) than 2 µm per 300 mm length; **and**
    - c. A vertical straightness of less (better) than 2 µm over full travel per 300 mm length;
  - 5. Single-point diamond-cutting tool inserts having all of the following characteristics:
    - a. A flawless and chip-free cutting edge when magnified 400 times in any direction;
    - b. A cutting radius out-of-roundness less (better) than 0.002 mm TIR (also peak-to-peak); **and**
    - c. A cutting radius between 0.1 and 5.0 mm, inclusive.

#### 4501. cont'd.

2. g. Specially designed components or sub-assemblies, as follows, capable of upgrading, according to the manufacturer's specifications, "numerical control" units, motion control boards, machine tools, or feedback devices to or above the levels controlled in sub-items 4501.2.a., b., c., 4501.2.f.2., or 3.:
  1. Printed circuit boards with mounted components and "software" therefor;
  2. "Compound rotary tables."
3. Dimensional inspection machines, devices, or systems and specially designed software therefor:
  - a. Computer controlled or numerically controlled dimensional inspection machines having both of the following characteristics:
    1. two or more axes; **and**
    2. a one-dimensional length "measurement uncertainty" equal to or less (better) than  $(1.25 + L/1000) \mu\text{m}$  tested with a probe of an "accuracy" of less (better) than  $0.2 \mu\text{m}$  (L is the measured length in millimetres) (Ref: VDI/VDE 2617 parts 1 and 2);
  - b. Linear and angular displacement measuring devices, as follows:
    1. Linear measuring instruments having any of the following characteristics:
      - a. non-contact type measuring systems with a "resolution" equal to or less (better) than  $0.2 \mu\text{m}$  within a measuring range up to  $0.2 \text{ mm}$ ;
      - b. linear variable differential transformer (LVDT) systems having both of the following characteristics:
        1. "linearity" equal to or less (better) than  $0.1\%$  within a measuring range up to  $5 \text{ mm}$ ; **and**
        2. drift equal to or less (better) than  $0.1\%$  per day at a standard ambient test room temperature  $\pm 1^\circ \text{K}$ ; or
      - c. measuring systems that have both of the following characteristics:
        1. contain a "laser"; **and**
        2. maintain for at least 12 hours, over a temperature range of  $\pm 1^\circ \text{K}$  around a standard temperature and a standard pressure:
          - a. a "resolution" over their full scale of  $0.1 \mu\text{m}$  or better; **and**
          - b. with a "measurement uncertainty" equal to or less (better) than  $(0.2 + L/2000) \mu\text{m}$  (L is the measured length in millimetres); except measuring interferometer systems, without closed or open loop feedback containing a "laser" to measure slide movement errors of machine tools, dimensional inspection machines, or similar equipment.
    2. angular measuring instruments having an "angular position deviation" equal to or less (better) than  $0.00025^\circ$ ;

#### Note:

*This Item does not control optical instruments, such as autocollimators, using collimated light to detect angular displacement of a mirror.*

- c. Systems for simultaneously linear-angular inspection of hemishells, having both of the following characteristics:
  1. "measurement uncertainty" along any linear axis equal to or less (better) than  $3.5 \mu\text{m}$  per  $5 \text{ mm}$ ; **and**
  2. "angular position deviation" equal to or less than  $0.02^\circ$ .

#### Note:

*Specially designed software for the systems described in paragraph (c) of this item includes software for simultaneous measurements of wall thickness and contour.*

#### Technical notes:

1. Machine tools that can be used as measuring machines are included in Item 4501 if they meet or exceed the criteria specified for the machine tool function or the measuring machine function.
2. A machine described in 4501.3 is covered by this item if it exceeds the control threshold anywhere within its operating range.
3. The probe used in determining the measurement uncertainty of a dimensional inspection system shall be as described in VDI/VDE 2617 parts 2, 3 and 4.
4. All parameters of measurement values in this item represent plus/minus, i.e. not total band.

4. Vacuum or controlled environment (Inert gas) induction furnaces capable of operation above  $850^\circ\text{C}$  and having induction coils  $600 \text{ mm}$  ( $24 \text{ in.}$ ) or less in diameter and power supplies specially designed for induction furnaces with a power supply of  $5 \text{ Kw}$  or more.

#### Technical note:

*This item does not include furnaces designed for the processing of semiconductor wafers.*

5. "Isostatic presses" capable of achieving a maximum working pressure of  $69 \text{ Mpa}$  ( $10,000 \text{ psi}$ ) or greater and having a chamber cavity with an inside diameter in excess of  $152 \text{ mm}$  ( $6 \text{ in.}$ ) and specially designed dies and molds and controls and "specially designed software" therefor.

#### Technical notes:

1. The inside chamber dimension is that of the chamber in which both the working temperature and the working pressure are achieved and does not include fixtures. That dimension will be the smaller of either the inside diameter of the pressure chamber or the inside diameter of the insulated furnace chamber, depending on which of the two chambers is located inside the other.
2. "Isostatic presses"  
Equipment capable of pressurizing 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.
6. "Robots" and "end-effectors" having either of the following characteristics:
  - a. Specially designed to comply with national safety standards applicable to handling high explosives (for example, meeting electrical code ratings for high explosives); **or**
  - b. Specially designed or rated as radiation hardened to withstand greater than  $5 \times 10^4$  grays (Si) ( $5 \times 10^6$  rad (Si) without operational degradation; and specially designed controllers and "specially designed software" therefor.

#### Technical notes:

*"Robot" as described in item 4501.6 does not include robots specially designed for non-nuclear industrial applications such as automobile paint-spraying booths.*

7. Vibration test equipment using digital control techniques and feedback or closed loop test equipment and software therefor capable of vibrating a system at  $10 \text{ g RMS}$  or more between  $20 \text{ Hz}$  and  $2000 \text{ Hz}$ , imparting forces of  $50 \text{ kN}$  ( $11,250 \text{ lbs}$ ) or greater.
8. Vacuum and controlled atmosphere metallurgical melting and casting furnaces as follows; and specially configured computer control and monitoring systems and "specially designed software" therefor:
  - a. Arc remelt and casting furnaces with consumable electrode capacities between  $1000 \text{ cm}^3$  and  $20,000 \text{ cm}^3$  and capable of operating with melting temperatures above  $1700^\circ\text{C}$ ,
  - b. Electron beam melting and plasma atomization and melting furnaces with a power of  $50 \text{ kW}$  or greater and capable of operating with melting temperatures above  $1200^\circ\text{C}$ .

#### 4502. Nuclear-related Dual-use Materials

1. Aluminum alloys capable of an ultimate tensile strength of  $460 \text{ Mpa}$  ( $.46 \times 10^9 \text{ N/m}^2$ ) or more at  $293 \text{ K}$  ( $20^\circ\text{C}$ ), in the form of tubes or solid forms (including forgings) with an outside diameter of more than  $75 \text{ mm}$  ( $3 \text{ in.}$ )

#### Note:

*"Capable of" encompasses aluminum alloys before or after heat treatment.*

2. Beryllium metal, alloys that contain more than 50 weight per cent beryllium, compounds that contain beryllium and manufactures thereof, except:
  - a. Beryllium metal windows for X-ray machines;
  - b. Oxide shapes in fabricated or semi-fabricated forms especially designed for electronic component parts or as substrates for electronic circuits.

#### Note:

*Item 4502.2 includes waste and scrap containing beryllium as defined above.*

3. Bismuth (high-purity: 99.99% or greater) with less than 10 parts per million silver content.
4. Boron and boron compounds, mixtures and loaded materials in which the boron-10 isotope content is more than 20 weight per cent of the total boron content.
5. Calcium (high-purity) containing both, less than 1000 parts per million by weight of metallic impurities other than magnesium and less than 10 parts per million of boron.
6. Chlorine trifluoride ( $\text{ClF}_3$ )

#### 4502. cont'd.

7. Crucibles made of materials resistant to liquid actinide metals, as follows:
  - a. Crucibles with a volume of between 150 ml and 8 liters and made of or coated with any of the following materials having a purity of 98% or greater:
    1. Calcium fluoride ( $\text{CaF}_2$ ),
    2. Calcium zirconate (metazirconate) ( $\text{Ca}_2\text{ZrO}_3$ )
    3. Cerium sulfide ( $\text{Ce}_2\text{S}_3$ )
    4. Erbium oxide (erbia) ( $\text{Er}_2\text{O}_3$ ),
    5. Hafnium oxide (hafnia) ( $\text{HfO}_2$ ),
    6. Magnesium oxide ( $\text{MgO}$ ),
    7. Nitrided niobium-titanium-tungsten alloy (approximately 50% Nb, 30%Ti, 20%W)
    8. Yttrium oxide (yttria) ( $\text{Y}_2\text{O}_3$ )
    9. Zirconium oxide (zirconia) ( $\text{ZrO}_2$ )
  - b. Crucibles with a volume of between 50 ml and 2 liters and made of or lined with tantalum, having a purity of 99.9% or greater.
  - c. Crucibles with a volume of between 50 ml and 2 liters and made of or lined with tantalum (having a purity of 98% or greater) coated with tantalum carbide, nitride, or boride (or any combination of these).
8. Fibrous and filamentary, composite structures as follows:
  - a. Carbon or aramid fibrous and filamentary materials having a "specific modulus" of  $12.7 \times 10^6$  m or greater or a "specific tensile strength" of  $23.5 \times 10^4$  m or greater; **or**
  - b. Glass fibrous and filamentary materials having a "specific modulus" of  $3.18 \times 10^6$  m or greater or a "specific tensile strength" of  $7.62 \times 10^4$  m or greater
  - c. composite structures in the form of tubes with an inside diameter of between 75 mm (3 in.) and 400 mm (16 in.) made with "fibrous and filamentary" materials controlled in (a.) above

#### Note:

- a. "Fibrous and filamentary" materials include continuous monofilaments, continuous yarns and tapes.
- b. "Specific modulus" is the Young's modulus in  $\text{N/m}^2$  divided by the specific weight in  $\text{N/m}^3$  when measured at a temperature of  $23 \pm 2^\circ\text{C}$  and a relative humidity of  $50 \pm 5\%$
- c. "Specific tensile strength" is the ultimate tensile strength in  $\text{N/m}^2$  divided by the specific weight in  $\text{N/m}^3$  when measured at a temperature of  $23 \pm 2^\circ\text{C}$  and a relative humidity of  $50 \pm 5\%$

9. Hafnium metal, alloys and compounds that contain more than 60 weight percent hafnium and manufactures thereof.
10. Lithium (isotopically enriched in lithium-6), as follows:
  - a. Metal hydrides or alloys containing lithium enriched in the 6 isotope  $^6\text{Li}$  to a concentration higher than the one existing in nature, (7.5% on an atom-percentage basis); **and**
  - b. Any other materials that contain lithium enriched in the 6 isotope,  $^6\text{Li}$  (including compounds, mixtures and concentrates) except where incorporated in thermoluminescent dosimeters.
11. Magnesium (high-purity) containing both less than 200 parts per million by weight of metallic impurities other than calcium and less than 10 parts per million of boron.
12. Maraging steel capable of an ultimate tensile strength of 2050 Mpa ( $2.050 \times 10^9 \text{ N/m}^2$ ) ( $300,000 \text{ lb/in.}^2$ ) or more at 293K ( $20^\circ\text{C}$ ) except forms in which no linear dimension exceeds 75 mm.

#### Note:

"Capable of" encompasses maraging steel before or after heat treatment.

13. Radium-226 except radium contained in medical applications.
14. Titanium alloys capable of an ultimate tensile strength of 900 MPa ( $.9 \times 10^9 \text{ N/m}^2$ ) ( $130,500 \text{ lb/in.}^2$ ) or more at 293K ( $20^\circ\text{C}$ ), in the form of tubes or solid forms (including forgings) with an outside diameter of more than 75 mm (3 in.)

#### Note:

"Capable of" encompasses titanium alloys before or after heat treatment.

15. Tungsten as follows:

Parts made of tungsten, tungsten carbide, or tungsten alloys containing more than 90 weight percent, having a mass greater than 20 kg and a hollow cylindrical symmetry (including cylinder segments) with an inside diameter greater than 100 mm (4 in.) but less than 300 mm (12 in.), except parts specifically designed for use as weights or gamma-ray collimators.

16. Zirconium: (see also item 4004)

Zirconium metal, alloys containing more than 50 weight percent zirconium 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; except zirconium in the form of foil having a thickness not exceeding .10 mm (.004 in.)

#### Note:

Item 4502.16 includes waste and scrap containing zirconium as defined above.

#### 4503. Uranium isotope separation equipment and components

1. Electrolytic cells for fluorine production with a production capacity greater than 250 g of fluorine per hour.
2. Rotor fabrication and assembly equipment and bellows-forming mandrels and dies, as follows:
  - a. Rotor assembly equipment for assembly of gas centrifuge rotor tube sections, baffles and end caps. Such equipment includes precision mandrels, clamps and shrink fit machines.
  - b. Rotor straightening equipment for alignment of gas centrifuge rotor tube sections to a common axis. (Note: Normally such equipment will consist of precision measuring probes linked to a computer that subsequently controls the action of, for example, pneumatic rams used for aligning the rotor tube sections.)
  - c. Bellows-forming mandrels and dies for producing single-convolution bellows (bellows made of high-strength aluminum alloys, maraging steel, or high-strength filamentary materials). The bellows have all of the following dimensions:
    1. 75-mm to 400-mm (3-in. to 16-in.) inside diameter;
    2. 12.7 mm (0.5 in.) or more in length; **and**
    3. single convolution depth more than 2 mm (0.08 in.).
3. Centrifugal multiplane balancing machines, fixed or portable, horizontal or vertical, as follows:
  - a. Centrifugal balancing machines designed for balancing flexible rotors having a length of 600 mm or more and having all of the following characteristics:
    1. a swing or journal diameter of 75 mm or more;
    2. mass capability of from 0.9 to 23 kg (2 to 50 lb); **and**
    3. capable of balancing speed of revolution more than 5000 rpm;
  - b. Centrifugal balancing machines designed for balancing hollow cylindrical rotor components and having all of the following characteristics:
    1. a journal diameter of 75 mm or more;
    2. mass capability of from 0.9 to 23 kg (2 to 50 lb.);
    3. capable of balancing to a residual imbalance of 0.010 kg mm/kg per plane or better; **and**
    4. belt drive type;and "specially designed software" therefor.
4. Filament winding machines in which the motions for positioning, wrapping and winding fibres are coordinated and programmed in two or more axes, specially designed to fabricate composite structures or laminates from fibrous and filamentary materials and capable of winding cylindrical rotors of diameter between 75 mm (3 in.) and 400 mm (16 in.) and length of 600 mm (24 in.) or greater, coordinating and programming controls therefor; precision mandrels; and "specially designed software" therefor.
5. Frequency changers (also known as converters or inverters) or generators having all of the following characteristics:
  - a. A multiphase output capable of providing a power of 40 W or more;
  - b. Capable of operating in the frequency range between 600 and 2000 Hz;
  - c. Total harmonic distortion below 10%; **and**
  - d. Frequency control better than 0.1%.except such frequency changers especially designed or prepared to supply "motor stators" (as defined below) and having the characteristics listed in (b) and (d) above, together with a total harmonic distortion of less than 2% and an efficiency of greater than 80%.

#### Note:

"Motor Stators": Specially designed or prepared ring-shaped stators for high-speed multiphase AC hysteresis (or reluctance) motors for synchronous operation within a vacuum in frequency range of 600-2000 Hz and a power range of 50-1000 VA. The stators consist of multiphase windings on a laminated low-loss iron core comprising thin layers typically 2.0 mm (0.08 in.) thick or less.

#### 4503. cont'd.

6. Lasers, laser amplifiers and oscillators as follows:
  - a. Copper vapor lasers with 40 W or greater average output power operating at wavelengths between 500 nm and 600 nm;
  - b. Argon ion lasers with greater than 40 W average output power operating at wavelengths between 400 nm and 515 nm;
  - c. Neodymium-doped (other than glass) lasers as follows:
    1. having an output wavelength between 1000 nm and 1100 nm, being pulse-excited and Q-switched with a pulse duration equal to or greater than 1 ns and having either of the following:
      - a. A single-transverse mode output having an average output power exceeding 40 W;
      - b. A multiple-transverse mode output having an average output power exceeding 50 W;
    2. operating at a wavelength between 1000 nm and 1100 nm and incorporating frequency doubling giving an output wavelength between 500 nm and 550 nm with an average power at the doubled frequency (new wavelength) of greater than 40 W;
  - d. Tunable pulsed single-mode dye oscillators capable of an average power output of greater than 1 W, a repetition rate greater than 1 kHz, a pulse less than 100 ns and a wavelength between 300 nm and 800 nm;
  - e. Tunable pulsed dye laser amplifiers and oscillators, *except single mode oscillators*, with an average power output of greater than 30 W, a repetition rate greater than 1 kHz, a pulse width less than 100 ns and a wavelength between 300 nm and 800 nm;
  - f. Alexandrite lasers with a bandwidth of 0.005 nm or less, a repetition rate of greater than 125 Hz and an average power output greater than 30 W operating at wavelengths between 720 nm and 800 nm;
  - g. Pulsed carbon dioxide lasers with a repetition rate greater than 250 Hz, an average power output of greater than 500 W and a pulse of less than 200 ns operating at wavelengths between 9000 nm and 11,000 nm;

#### N.B.:

*This Item 4503.6.g. does not include higher power (typically 1 to 5 kW) industrial CO<sub>2</sub> lasers used in applications such as cutting and welding, as these latter lasers are either continuous wave or are pulsed with a pulse width more than 200 ns.*

- h. Pulsed excimer lasers (XeF, XeCL, KrF) with a repetition rate greater than 250 Hz and an average power output of greater than 500 W operating at wavelengths of between 240 and 360 nm;
- i. Para-hydrogen Raman shifters designed to operate at 16  $\mu\text{m}$  output wavelength and at a repetition rate greater than 250 Hz.

#### Technical note:

*Machine tools, measuring devices and associated technology that have the potential for use in the nuclear industry are included in items 4501.2 and 4501.3 of this list.*

7. Mass spectrometers capable of measuring ions of 230 atomic mass units or greater and having a resolution of better than 2 parts in 230 and ion sources therefor as follows:
  - a. Inductively coupled plasma mass spectrometers (ICP/MS);
  - b. Glow discharge mass spectrometers (GDMS);
  - c. Thermal ionization mass spectrometers (TIMS);
  - d. Electron bombardment mass spectrometers which have a source chamber constructed from or lined with or plated with materials resistant to UF<sub>6</sub>;
  - e. Molecular beam mass spectrometers as follows:
    1. which have a source chamber constructed from or lined with or plated with stainless steel or molybdenum and have a cold trap capable of cooling to 193 K (-80°C) or less; **or**
    2. which have a source chamber constructed from or lined with or plated with materials resistant to UF<sub>6</sub>;
  - f. Mass spectrometers equipped with a microfluorination ion source designed for use with actinide fluorides; except especially designed or prepared magnetic or quadrupole mass spectrometers capable of taking "on-line" samples of feed, product, or tails from UF<sub>6</sub> gas streams and having all of the following characteristic:
    1. Unit resolution for mass greater than 320;
    2. Ion sources constructed of or lined with nichrome or monel or nickel-plated;
    3. Electron bombardment ionization sources;
    4. Having a collector system suitable for isotopic analysis.

8. Instruments capable of measuring pressures up to 13 kPa (2 psi, 100 torr) to an accuracy of better than 1% (full-scale), with corrosion-resistant pressure-sensing elements constructed of nickel, nickel alloys, phosphor bronze, stainless steel, aluminum, or aluminum alloys.
9. Valves 5 mm (0.2 in.) or greater in diameter, with a bellows seal, wholly made of or lined with aluminum, aluminum alloy, nickel, or alloy containing 60% or more nickel, either manually or automatically operated.
10. Superconducting solenoidal electromagnets with all of the following characteristics:
  - a. capable of creating magnetic fields of more than 2 teslas (20 kilogauss);
  - b. with an L/D (length divided by inner diameter) greater than 2;
  - c. with an inner diameter of more than 300 mm; **and**
  - d. with a magnetic field uniform to better than 1% over the central 50% of the inner volume.

#### Note:

*Item 4503.10 does not include magnets specially designed for and exported as parts of medical nuclear magnetic resonance (NMR) imaging systems. "As part of" does not prohibit separate shipments from different sources provided the related export documents clearly specify the "part of" relationship.*

11. Vacuum pumps with an input throat size of 38 cm (15 in.) or greater with a pumping speed of 15,000 liters/second or greater and capable of producing an ultimate vacuum better than 10<sup>-4</sup> Torr (0.76 x 10<sup>-4</sup> mbar).

#### Technical note:

*The ultimate vacuum is determined at the input of the pump with the input of the pump blocked off.*

12. Direct current high-power supplies capable of continuously producing, over a time period of 8 hours, 100 V or greater with current output of 500 amps or greater and with current or voltage regulation better than 0.1%.
13. High-voltage direct current power supplies capable of continuously producing, over a time period of 8 hours, 20,000 V or greater with current output of 1 amp or greater and with current or voltage regulation better than 0.1%.
14. Electromagnetic isotope separators, designed for or equipped with, single or multiple ion sources capable of providing a total ion beam current of 50 mA or greater.

#### Notes:

1. *This entry will control separators capable of enriching stable isotopes as well as those for uranium. A separator capable of separating the isotopes of lead with a one-mass unit difference is inherently capable of enriching the isotopes of uranium with a three-unit mass difference.*
2. *This entry includes separators with the ion sources and collectors both in the magnetic field and those configurations in which they are external to the field.*
3. *A single 50-mA ion source will produce less than 3 g of separated HEU per year from natural abundance feed.*

#### 4504. Heavy water production plant related equipment

1. Specialized packings for use in separating heavy water from ordinary water, made of phosphor bronze mesh or copper (both chemically treated to improve wettability) and designed for use in vacuum distillation towers.
2. pumps circulating solutions of diluted or concentrated potassium amide catalyst in liquid ammonia (KNH<sub>2</sub>, NH<sub>3</sub>), with **all** of the following characteristics:
  - a. airtight (i.e. hermetically sealed);
  - b. for **concentrated** potassium amide solutions (1% or greater), operating pressure of 1.5-60 MPa [15-600 atmospheres(atm)]; for **dilute** potassium amide solutions (less than 1%), operating pressure of 20-60 Mpa (200-600 atm); **and**
  - c. a capacity greater than 8.5 m<sup>3</sup>/h (5 cubic feet per minute).
3. Water-hydrogen sulfide exchange tray columns constructed from fine carbon steel (such as ASTM A.516) with a diameter of 1.8 m (6 ft.) or greater to operate at a nominal pressure of 2 MPa (300 psi) or greater, **except** columns which are specially designed or prepared for the production of heavy water. Internal contactors of the columns are segmented trays with an effective assembled diameter of 1.8 m (6 ft.) or greater, such as sieve trays, valve trays, bubble cap trays and turbogrid trays designed to facilitate countercurrent contacting and constructed of materials resistant to corrosion by hydrogen sulfide/water mixtures, such as 304L or 316 stainless steel.

4. Hydrogen-cryogenic distillation columns having **all** of the following applications:
  - a. designed to operate with internal temperatures of -238°C (35 K) or less;
  - b. designed to operate at internal pressure of 0.5 to 5 MPa (5 to 50 atmospheres);
  - c. constructed of fine-grain stainless steels of the 300 series with low sulphur content or equivalent cryogenic and H<sub>2</sub>-compatible materials; **and**
  - d. with internal diameters of 1 m or greater and effective lengths of 5 m or greater.
5. Ammonia synthesis converters, ammonia synthesis units in which the synthesis gas (nitrogen and hydrogen) is withdrawn from an ammonia/hydrogen high-pressure exchange column and the synthesized ammonia is returned to said column.

#### 4505. Implosion systems development equipment

1. Flash x-ray generators or pulsed electron accelerators with peak energy of 500 keV or greater, as follows, **except** accelerators that are component parts of devices designed for purposes other than electron beam or x-ray radiation (electron microscopy, for example) and those designed for medical purposes:
  - a. Having an accelerator peak electron energy of 500 keV or greater but less than 25 MeV and with a figure of merit (K) of 0.25 or greater, where K is defined as:  

$$K = 1.7 \times 10^3 V^{2.65} Q,$$
 where V is the peak electron energy in million electron volts and Q is the total accelerated charge in coulombs if the accelerator beam pulse duration is less than or equal to 1 μs; if the accelerator beam pulse duration is greater than 1 μs, Q is the maximum accelerated charge in 1 μs [Q equals the integral of i with respect to t, over the lesser of 1 μs or the time duration of the beam pulse (Q = ∫idt), where i is beam current in amperes and t is time in seconds] or,
  - b. Having an accelerator peak electron energy of 25 MeV or greater and a peak power greater than 50 MW. [Peak power = (peak potential in volts) x (peak beam current in amperes).]

##### Technical note:

**Time duration of the beam pulse** – In machines, based on microwave accelerating cavities the time duration of the beam pulse is the lesser of 1 μs or the duration of the bunched beam packet resulting from one microwave modulator pulse.

**Peak beam current** – In machines based on microwave accelerating cavities, the peak beam current is the average current in the time duration of a bunched beam packet.

2. Multistage light gas guns or other high-velocity gun systems (coil, electromagnetic, electrothermal, or other advanced systems) capable of accelerating projectiles to 2 km per second or greater.
3. Mechanical rotating mirror cameras  
 Mechanical framing cameras with recording rates greater than 225,000 frames second; streak cameras with writing speeds greater than 0.5 mm per microsecond; and parts, including specially designed synchronizing electronics and specially designed rotor assemblies (consisting of turbines, mirrors and bearings).
4. Electronic streak and framing cameras and tubes as follows:
  - a. Electronic streak cameras capable of 50 ns or less time resolution and streak tubes therefor;
  - b. Electronic (or electronically shuttered) framing cameras capable of 50 ns or less frame exposure time;
  - c. Framing tubes and solid-state imaging devices for use with cameras controlled in sub-item (b) above, as follows:
    1. proximity focused image intensifier tubes having the photocathode deposited on a transparent conductive coating to decrease photocathode sheet resistance;
    2. gate silicon intensifier target (SIT) vidicon tubes, where a fast system allows gating the photoelectrons from the photocathode before they impinge on the SIT plate;
    3. Kerr or pocket cell electro-optical shuttering; **or**
    4. Other framing tubes and solid-state imaging devices having a fast-image gating time of less than 50 ns specially designed for cameras controlled by sub-item (b) above.

5. Specialized instrumentation for hydrodynamic experiments as follows:
  - a. Velocity interferometers for measuring velocities in excess of 1 km per second during time intervals less than 10 μs. (VISARs, Doppler laser interferometers, DLIs, etc.);
  - b. manganin gauges for pressures greater than 100 kilobars; **or**
  - c. quartz pressure transducers for pressures greater than 100 kilobars.

#### 4506. Explosives and related equipment

1. Detonators and multipoint initiation systems (exploding bridge wire, slapper, etc.)
  - a. Electrically driven explosive detonators as follows:
    1. exploding bridge (EB);
    2. exploding bridge wire (EBW);
    3. slapper; **and**
    4. exploding foil initiators (EFI).
  - b. Arrangements using single or multiple detonators designed to nearly simultaneously initiate an explosive surface (over greater than 5000 mm<sup>2</sup>) from a single firing signal (with an initiation timing spread over the surface of less than 2.5 μs).

##### Technical note:

The detonators described in Item 4506.1 all utilize a small electrical conductor (bridge, bridge wire, or foil) that explosively vaporizes when a fast, high-current electrical pulse is passed through it. In non-slapper types, the exploding conductor starts a chemical detonation in a contacting high-explosive material such as PETN (pentaerythritoltetranitrate). In slapper detonators, the explosive vaporization of the electrical conductor drives a "flyer" or "slapper" across a gap and the impact of the slapper on an explosive starts a chemical detonation. The slapper in some designs is driven by magnetic force. The term "exploding foil" detonator may refer to either an EB or a slapper-type detonator. Also, the word "initiator" is sometimes used in place of the word "detonator."

##### Note:

Item 4506.1 does not include detonators using only primary explosives, such as lead azide.

2. Electronic components for firing sets (switching devices and pulse discharge capacitors)
  - a. Switching devices
    1. Cold-cathode tubes (including gas krytron tubes and vacuum spraytron tubes), whether gas filled or not, operating similarly to a spark gap, containing three or more electrodes and having all of the following characteristics:
      - a. Anode peak voltage rating of 2500 V or more,
      - b. Anode peak current rating of 100 A or more,
      - c. Anode delay time of 10 μs or less **and**
    2. Triggered spark-gaps having an anode delay time of 15 μs or less and rated for a peak current of 500 A or more;
    3. Modules or assemblies with a fast switching function having all of the following characteristics:
      - a. Anode peak voltage rating greater than 2000 V;
      - b. Anode peak current rating of 500 A or more; **and**
      - c. turn-on time of 1 μs or less.
  - b. Capacitors with the following characteristics:
    1. Voltage rating greater than 1.4 kV, energy storage greater than 10 J, capacitance greater than 0.5 μF and series inductance less than 50 nH, **or**
    2. Voltage rating greater than 750 V, capacitance greater than 0.25 μF and series inductance less than 10 nH.
3. Firing sets and equivalent high-current pulse generators (for controlled detonators), as follows:
  - a. Explosive detonator firing sets designed to drive multiple controlled detonators covered under item 4506.1. above;
  - b. Modular electrical pulse generators (pulsers) designed for portable, mobile, or ruggedized use (including xenon flash-lamp drivers) having all the following characteristics:
    1. capable of delivering their energy in less than 15 μs;
    2. having an output greater than 100 A;
    3. having a rise time of less than 10 μs into loads of less than 40 ohms. (Rise time is defined as the time interval from 10% to 90% current amplitude when driving a resistive load);

#### 4506. cont'd.

3. b. 4. enclosed in a dust-tight enclosure;
5. no dimension greater than 25.4 cm (10 in.);
6. weight less than 25 kg (55 lb.); and
7. specified for use over an extended temperature range (-50°C to 100°C) or specified as suitable for aerospace use.
4. High explosives or substances or mixtures containing more than 2% of any of the following:
  - a. Cyclotetramethylenetetranitramine (HMX);
  - b. Cyclotrimethylenetrinitramine (RDX);
  - c. Triaminotrinitrobenzene (TATB);
  - d. Any explosive with a crystal density greater than 1.8 g/cm<sup>3</sup> and having a detonation velocity greater than 8000 m/s; or
  - e. Hexanitrostilbene (HNS).

#### 4507. Nuclear testing equipment and components

1. Oscilloscopes and transient recorders and specially designed components as follows: plug-in units, external amplifiers, pre-amplifiers, sampling devices and cathode ray tubes for analog oscilloscopes.
  - a. Non-modular analog oscilloscopes having a "bandwidth" of 1 GHz or greater;
  - b. Modular analog oscilloscope systems having either of the following characteristics:
    1. a mainframe with a "bandwidth" of 1 GHz or greater; or
    2. Plus-in modules with an individual "bandwidth" of 4 GHz or greater;
  - c. Analog sampling oscilloscopes for the analysis of recurring phenomena with an effective "bandwidth" greater than 4 GHz;
  - d. Digital oscilloscopes and transient recorders, using analog-to-digital conversion techniques, capable of storing transients by sequentially sampling single-shot inputs at successive intervals of less than 1 ns (greater than 1 giga-sample per second), digitizing to 8 bits or greater resolution and storing 256 or more samples.

##### **Technical note:**

"Bandwidth" is defined as the band of frequencies over which the deflection on the cathode ray tube does not fall below 70.7% of that at the maximum point measured with a constant input voltage to the oscilloscope amplifier.

2. Photomultiplier tubes with a photocathode area of greater than 20 cm<sup>2</sup> having an anode pulse rise time of less than 1 ns.
3. High-speed pulse generators with output voltages greater than 6 V into a less than 55-ohm resistive load and with pulse transition times less than 500 ps (defined as the time interval between 10% and 90% voltage amplitude).

#### 4508. Other

1. Neutron generator systems, including tubes, designed for operation without an external vacuum system and utilizing electrostatic acceleration to induce a tritium-deuterium nuclear reaction.
2. Equipment related to nuclear material handling and processing and to nuclear reactors as follows:
  - a. Remote manipulators that provide mechanical translation of human operator actions by electrical, hydraulic, or mechanical means to an operating arm and terminal fixture that can be used to provide remote actions in radiochemical separation operations and "hot cells." The manipulators have a capability to penetrate 0.6 m or more (2 ft. or more) of cell wall or, alternatively, bridge over the top of a cell wall with a thickness of 0.6 m or more (2 ft. or more);
  - b. High-density (lead glass or other) radiation shielding windows greater than 0.3 m (1 ft.) on a side and with a density greater than 3 g/cm<sup>3</sup> and a thickness of 100 mm or greater and specially designed frames therefor;
  - c. Radiation-hardened TV cameras specially designed or rated as radiation hardened to withstand greater than 5 X 10<sup>4</sup> grays (Si) (5 X 10<sup>6</sup> rad (Si)) without operational degradation and specially designed lenses used therein.
3. Tritium. See also Item 4012.

Tritium, tritium compounds and mixtures containing tritium in which the ratio of tritium to hydrogen by atoms exceeds 1 part in 1000 **except** a product or device containing not more than 40 Ci of tritium in any chemical or physical form.
4. Facilities or plants for the production, recovery, extraction, concentration, or handling of tritium and equipment as follows (see also Item 4205):
  - a. Hydrogen or helium refrigeration units capable of cooling to -250°C (23 K) or less, with heat removal capacity greater than 150 watts or
  - b. Hydrogen isotope storage and purification systems using metal hydrides as the storage, or purification medium.
5. Platinized catalysts specially designed or prepared for promoting the hydrogen isotope exchange reaction between hydrogen and water for the recovery of tritium from heavy water or for the production of heavy water.
6. Helium in any form isotopically enriched in the helium-3 isotope, whether or not mixed with other materials or contained in any equipment or device, except products or devices containing less than 1 g of helium-3.
7. Alpha-emitting radionuclides and equipment containing such radionuclides as follows:

All alpha-emitting radionuclides having an alpha half-life of 10 days or greater but less than 200 years, including compounds and mixtures containing these radionuclides with a total alpha activity of 1 curie per kilogram (37 GBq/kg) or greater except for devices containing less than 100 millicuries (3.7 GBq) of alpha activity per device.

## Annex I

### Definitions of terms used in Group 4 – Part II

"accuracy" – Usually measured in terms of inaccuracy, defined as the maximum deviation, positive or negative, of an indicated value from an accepted standard or true value.

"adaptive control" – A control system that adjusts the response from conditions detected during the operation (Ref. ISO 2806-1980)

"angular position deviation" – The maximum difference between angular position and the actual, very accurately measured angular position after the workpiece mount of the table has been turned out of its initial position.

(Reference: VID/VDE 2617. Draft: "Rotary table on coordinate measuring machines.")

"basic scientific research" – Experimental or theoretical work undertaken principally to acquire new knowledge of the fundamental principles of phenomena and observable facts, not primarily directed toward a specific practical aim or objective.

"camming" (axial displacement) – Axial displacement in one revolution of the main spindle measured in a plane perpendicular to the spindle faceplate at a point next to the circumference of the spindle faceplate (REF. ISO 230 Part 1-1986, paragraph 5.63)

"compound rotary table" – A table allowing the workpiece to rotate and tilt about two non-parallel axes, which can be coordinated simultaneously for "contouring control."

"contouring control" – Two or more "numerically controlled" motion 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 2806-1980).

"development" – is related to all phases before "production" and includes:

- design
- design research
- design analysis
- design concepts
- assembly and testing of prototypes
- pilot production schemes
- design data
- process of transforming design data into a product
- configuration design
- integration design
- layouts

"digital computer" – Equipment which can, in the form of one or more discrete variables:

- a. Accept data;
- b. Store data or instruction 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.*

"End-effectors" – as described in Item 4501.6 include grippers, "active tooling units," and any other tooling that is attached to the baseplate on the end of a "robot" manipulator arm.

"flexible manufacturing unit (FMU)" – [sometimes also referred to as "flexible manufacturing system" (FMS) or "flexible manufacturing cell (FMC)"]. An entity which includes a combination of at least:

- a. A "digital computer" including its own "main storage" and its own related equipment; and
- b. Two or more of the following:
  1. A machine tool described in Section 4501.2;
  2. A dimensional inspection machine described in Section 4501.3;
  3. A "robot" controlled by Section 4501.6.;
  4. Digitally controlled equipment controlled by Section 4503.4.

"in the public domain" – "In the public domain", as it applies herein, means technology that has been made available without restrictions upon its further dissemination. (Copyright restrictions do not remove technology from being in the public domain.)

"laser" – An assembly of components which produce coherent light that is amplified by stimulated emission of radiation.

"linearity" – (Usually measured in terms of nonlinearity) is the maximum deviation of the actual characteristic (average of upscale and downscale readings), positive or negative, from a straight line so positioned as to equalize and minimize the maximum deviations.

"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.

"measurement uncertainty" – The characteristic parameter which specifies in what range around the output value the correct value of the measurable variable lies with a confidence level of 95%. It includes the uncorrected systematic deviations, the uncorrected backlash and the random deviations (Reference: VDI/VDE 2617).

"microprogram" – 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.

"motion control board" – An electronic assembly specially designed to provide a computer system with the capability to coordinate simultaneously the motion of axes of machine tools for "contouring control."

"numerical control" – 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).

"part program" – An ordered set of instructions in a language and in a format required to cause operations to be effected under automatic control, which is either written in the form of a machine program on an input medium or prepared as input data for processing in a computer to obtain a machine program (Ref. ISO 2806-1980).

"positioning accuracy" – Of "numerically controlled" machine tools is to be determined and presented in accordance with paragraph 2.13, in conjunction with the requirements below:

a. Test conditions (ISO/DIS/230/2, paragraph 3):

1. For 12 hours before and during measurements, the machine tool and accuracy measuring equipment will be kept at the same ambient temperature. During the premeasurement time, the slides of the machine will be continuously cycled identically to the way they will be cycled during the accuracy measurements;
2. The machine shall be equipped with any mechanical, electronic, or software compensation to be exported with the machine;
3. Accuracy of measuring equipment for the measurements shall be at least four times more accurate than the expected machine tool accuracy;
4. Power supply for slide drives shall be as follows:
  - a. Line voltage variation shall not be greater than  $\pm 10\%$  of nominal rated voltage;
  - b. Frequency variation shall not be greater than  $\pm 2$  Hz of normal frequency;
  - c. Lineouts or interrupted service are not permitted.

b. Test Program (paragraph 4):

1. Feed rate (velocity of slides) during measurement shall be the rapid traverse rate;

#### **N.B.:**

*In the case of machine tools which generate optical quality surfaces, the feed rate shall be equal to or less than 50 mm per minute;*

2. Measurements shall be made in an incremental manner from one limit of the axis travel to the other without returning to the starting position for each move to the target position;
  3. Axes not being measured shall be retained at mid-travel during test of an axis.
- c. Presentation of test results (paragraph 2): The results of the measurements must include:
1. "positioning accuracy" (A) **and**
  2. The mean reversal error (B).

"production" – means all production phases such as:

- construction
- production engineering
- manufacture
- integration
- assembly (mounting)
- inspection
- testing
- quality assurance

"program" – 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.

"resolution" – The least increment of a measuring device; on digital instruments, the least significant bit (Reference: ANSI B-89.1.12).

"robot" – 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:

- a. Is multifunctional;
- b. Is capable of positioning or orienting material, parts, tools or special devices through variable movements in three-dimensional space;
- c. Incorporates three or more closed or open loop servo-devices which may include stepping motors; **and**
- d. Has "user-accessible programmability" by means of teach/playback method or by means of an electronic computer which may be a programmable logic controlled, i.e. without mechanical intervention.

**N.B.:**

The above definition does not include the following devices:

- a. Manipulation mechanisms which are only manually/teleoperator controllable;
- b. Fixed sequence manipulation mechanisms which are automated moving devices, operating according to mechanically fixed programmed motions. The program 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;
- c. Mechanically controlled variable sequence manipulation mechanisms which are automated moving devices, operating according to mechanically fixed programmed motions. The program 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 program patterns. Variations or modifications of the program pattern (e.g. changes of pins or exchanges of cams) in one or more motion axes are accomplished only through mechanical operations;

- d. Non-servo-controlled variable sequence manipulation mechanisms which are automated moving devices, operating according to mechanically fixed programmed motions. The program is variable, but the sequence proceeds only by the binary signal from mechanically fixed electrical binary devices or adjustable stops;
- e. Stacker cranes 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.

"run-out"(out-of-true running) – Radial displacement in one revolution of the main spindle measured in a plane perpendicular to the spindle axis at a point on the external or internal revolving surface to be tested (Ref. ISO 230 Part 1-19986, paragraph 5.61).

"sensors" – Detectors of a physical phenomenon, the output of which (after conversion into a signal that can be interpreted by a controller) is able to generate "programs" or modify programmed instructions or numerical program 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.

"software" – A collection of one or more "programs" or "microprograms" fixed in any tangible medium of expression.

"Specially designed software" – The minimum "operating systems", "diagnostic systems", "maintenance systems" and "application software" necessary to be executed on 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 "programs."

"tilting spindle" – A tool-holding spindle that, during the machining process, alters the angular position of its centre line with respect to any other axis.

"use" – Operation, installation (including on-site installation), maintenance (checking), repair, overhaul and refurbishing.

"user-accessible programmability" – The facility allowing a user to insert, modify or replace "programs" by means other than:

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

## Group 5 – Miscellaneous Goods

### 5000. Any specimen of species of wild fauna or flora or derivatives thereof that are 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., as attached to the November 13, 1989 Notification to that Convention, in accordance with item 8 of that Notification; (*All destinations*); **or**
- b. Appendix III to the Convention referred to in paragraph (a), as attached to the June 20, 1991 Notification to that Convention, in accordance with item 4 of that Notification. (*All destinations*)

### 5001. Pancreas glands of cattle and calves. (*All destinations*)

### 5011. Human serum albumin. (*All destinations*)

### 5101. Logs of all species of wood. (*All destinations*)

### 5102. Pulpwood of all species of wood. (*All destinations*)

### 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*)

### 5202. Roe Herring

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*)

## 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*)

### 5500. Prohibited weapons, as follows:

- a. prohibited weapons described in paragraph (c), (e) or (f) of the definition "prohibited weapon" in subsection 84(1) of the *Criminal Code*.
- b. any component of a prohibited weapon referred to in paragraph (a), that is an assembly or subassembly that contains one or more parts described in paragraph (c);
- c. any part that is a piece of the action of a prohibited weapon referred to in paragraph (a), including the bolt or bolt-carrier, that is designed to enable the prohibited weapon to discharge bullets in rapid succession during one pressure of the trigger, whether or not the part permits the discharge to be limited to a single bullet for each such pressure. (*All destinations*)

## Group 6 – Missile Technology Control Regime List

The definitions set out on page 72 of this guide apply in respect to this Group.

**6000. The export of "technology" for the "development", "production" or "use" of products embargoed in Group 6 is controlled except that "technology" which is the minimum necessary for the installation, operation, maintenance (checking) and repair of those products whose export has been authorised.**

*Controls do not apply to "technology" "in the public domain" or to "basic scientific research".*

**6001. Complete rocket systems (including ballistic missile systems, space launch vehicles, and sounding rockets) and unmanned air vehicle systems (including cruise missile systems, target drones and reconnaissance drones) capable of delivering at least a 500 kg payload to a range of at least 300 km as well as the specially designed "production facilities" for these systems.**

**6002. Complete subsystems "usable in" the systems in Item 6001, as follows, as well as the specially designed "production facilities", and "production equipment" therefor:**

- a. Individual rocket stages;
- b. Reentry vehicles, and equipment designed or modified therefor, as follows, except as provided in Note 1 below for those designed for non-weapon payloads:
  1. Heat shields and components thereof fabricated of ceramic or ablative materials;
  2. Heat sinks and components thereof fabricated of light-weight, high heat capacity materials;
  3. Electronic equipment specially designed for reentry vehicles;
- c. Solid or liquid propellant rocket engines, having a total impulse capacity of  $1.1 \times 10^6$  N-sec ( $2.5 \times 10^5$  lb-sec) or greater;
- d. "Guidance sets" capable of achieving system accuracy of 3.33 percent or less of the range (e.g. a CEP of 10 km or less at a range of 300 km) except as provided in Note 1 below for those designed for missiles with a range under 300 km or manned aircraft;
- e. Thrust vector control sub-systems, except as provided in Note 1 below for those designed for rocket systems that do not exceed the range/payload capability of Item 6001;
- f. Weapon or warhead safing, arming, fuzing and firing mechanisms, except as provided in Note 1 below for those designed for systems other than those in Item 6001.

### Notes to Item 6002:

1. Governments may permit the export of items identified as exceptions in b, d, e, and f above if the subsystem is exported subject to end use statements and quantity limits appropriate for the excepted end-use stated above.
2. CEP (circle of equal probability) is a measure of accuracy and is defined as the radius of the circle centered at the target, at a specific range, in which 50 percent of the payloads impact.
3. A "guidance set" integrates the process of measuring and computing a vehicle's position and velocity (i.e. navigation) with that of computing and sending commands to the vehicle's flight control systems to correct the trajectory.
4. Examples of methods of achieving thrust vector control which are covered by 6002.e include:
  - a. Flexible nozzle;
  - b. Fluid or secondary gas injection;
  - c. Movable engine or nozzle;
  - d. Deflection of exhaust gas stream (jet vanes or probes); or

e. Use of thrust tabs.

**6003. Propulsion components and equipment "usable in" the systems in Item 6001, as follows, as well as the specially designed "production facilities" and "production equipment" therefor, and flow-forming machines specified in Note 1:**

- a. Lightweight turbojet and turboprop engines (including turbocompound engines) that are small and fuel efficient;
- b. Ramjet/Scramjet/pulse jet/combined cycle engines, including devices to regulate combustion and specially designed components therefor;
- c. Rocket motor cases, "interior lining", "insulation" and nozzles therefor;
- d. Staging mechanisms, separation mechanisms, and interstages therefor;
- e. Liquid and slurry propellant (including oxidizers) control systems, and specially designed components therefor, designed or modified to operate in vibration environments of more than 10 g RMS between 20 Hz and 2,000 Hz.
- f. Hybrid rocket motors and specially designed components therefor.

### Notes to Item 6003:

1. Flow-forming machines, and specially designed components and specially designed software therefor, which:
  - a. according to the manufacturer's technical specification, can be equipped with numerical control units or a computer control, even when not equipped with such units at delivery; and
  - b. with more than two axes which can be coordinated simultaneously for contouring control.

### Technical Note:

Machines combining the function of spin-forming and flow-forming are for the purpose of this item regarded as flow-forming machines. This item does not include machines that are not usable in the production of propulsion components and equipments (e.g. motor cases) for systems in Item 6001.

2. a. The only engines covered in this subitem (a) above, are the following:
  1. Engines having both the following characteristics:
    - a. Maximum thrust value greater than 1000N (achieved uninstalled) excluding civil certified engines with a maximum thrust value greater than 8,890N (achieved uninstalled, and
    - b. Specific fuel consumption of 0.13kg/N/hr or less (at sea level static and standard conditions); or
  2. Engines designed and modified for systems in Item 6001, regardless of thrust or specific fuel consumption.
- b. Governments may permit the export of engines identified in Item 6003.c. as part of a manned aircraft or in quantities appropriate for replacement parts in manned aircraft.
3. In Item 6003.c, "interior lining" suited for the bond interface between the solid propellant and the case or insulating liner is usually a liquid polymer based dispersion of refractory or insulating materials. e.g. carbon filled HTPB or other polymer with added curing agents to be sprayed or screeded over a case interior.
4. In Item 6003. c, "insulation" intended to be applied to the components of a rocket motor, i.e. the case, nozzle inlets, case closures, includes cured or semi-cured compounded rubber sheet stock containing an insulating or refractory material. It may also be incorporated as stress relief boots or flaps.
5. The only servo valves and pumps covered in 6003.e. above, are the following:
  - a. Servo valves designed for flow rates of 24 liters per minute or greater, at an absolute pressure of 7,000 kPa (1,000 psi) or greater, that have an actuator response time of less than 100 msec;
  - b. Pumps, for liquid propellants, with shaft speeds equal or greater than 8,000 RPM or with discharge pressures equal to or greater than 7,000 kPa (1,000 psi).
6. Governments may permit the shipment of equipment in Item 6003.e. which is exported as part of a satellite.

**6004. Propellants and constituent chemicals for propellants as follows:**

- a. Propulsive substances:
  1. Hydrazine with a concentration of more than 70 percent and its derivatives including monomethylhydrazine (MMH);
  2. Unsymmetric dimethylhydrazine (UDMH);
  3. Ammonium perchlorate;

- a. 4. Spherical aluminium powder with particles of uniform diameter of less than  $500 \times 10^{-6}$  m (500 micrometer) and an aluminium content of 97 percent by weight or greater;
5. Metal fuels in particle sizes less than  $500 \times 10^{-6}$  m (500 microns), whether spherical, atomized, spheroidal, flaked or ground, consisting of 97 percent by weight or more of any of the following: zirconium, beryllium, boron, magnesium, zinc, and alloys of these: Misch metal;
6. Nitro-amines (cyclotetramethylene-tetranitramine (HMX), cyclotrimethylenetrinitramine (RDX));
7. Perchlorates, chlorates or chromates mixed with powdered metals or other high energy fuel components;
8. Carboranes, decaboranes, pentaboranes and derivatives thereof;
9. Liquid oxidizers, as follows:
  - a. Dinitrogen trioxide;
  - b. Nitrogen dioxide/dinitrogen tetroxide;
  - c. Dinitrogen pentoxide;
  - d. Inhibited Red Fuming Nitric Acid (IRFNA);
  - e. Compounds composed of fluorine and one or more of other halogens, oxygen or nitrogen.
- b. Polymeric substances:
  1. Carboxy-terminated polybutadiene (CTFB);
  2. Hydroxy-terminated polybutadiene (HTFB);
  3. Glycidyl azide polymer (GAP);
  4. Polybutadiene-acrylic acid (PBAA)
  5. Polybutadiene-acrylic acid-acrylonitrile (PBAN).
- c. Composite propellants including molded glue propellants and propellants with nitrated bonding;
- d. Other high energy density propellants such as Boron Slurry, having an energy density of  $40 \times 10^5$  joules/kg or greater;
- e. Other propellant additives and agents:
  1. Bonding agents, as follows:
    - a. tris (1-(2-methyl)aziridinyl) phosphine oxide (MAPO)
    - b. trimesoyl-1(2-ethyl) aziridine (HX-868, BITA);
    - c. "Tepanol" (HX0878), Reaction product of tetraethylenepentamine, acrylonitrile and glycidol;
    - d. "Tapan" (HX-879), Reaction product of tetraethylenepentamine and acrylonitrile;
    - e. Polyfunctional aziridine amides with isophthalic, trimesic, isocyanuric or trimethyladipic backbone also having a 2-methyl or 2-ethyl aziridine group (HX-752, HX-874 and HX-877);
  2. Curing agents and catalysts as follows:
    - a. Triphenyl bismuth (TPB);
  3. Burning rate modifiers as follows:
    - a. Catocene;
    - b. N-butyl-ferrocene;
    - c. Butacene;
    - d. Other ferrocene derivatives;
  4. Nitrate esters and nitrate plasticizers as follows:
    - a. Triethylene glycol dinitrate (TEGDN);
    - b. Trimethylolethane trinitrate (TMETC);
    - c. 1,2,4-butanetriol trinitrate (BTTN);
    - d. Diethylene glycol dinitrate (DEGDN);
  5. Stabilizers, as follows:
    - a. 2-nitrodiphenylamine;
    - b. N-methyl-p-nitroaniline;

**6005. Production technology, or "production equipment" (including its specially designed components) for:**

- a. Production, handling or acceptance testing of liquid propellants or propellant constituents described in Item 6004.;
- b. Production, handling, mixing, curing, casting, pressing, machining, extruding or acceptance testing of solid propellants or propellant constituents in Item 6004.

**Notes to Item 6005:**

1. Batch mixers or continuous mixers covered by (b) above, both with provision for mixing under vacuum in the range of zero to 13.326 kPa and with temperature control capability of the mixing chamber, are the following:
  - a. Batch mixers having:
    1. A total volumetric capacity of 110 litres (30 gallons) or more; **and**
    2. At least one mixing/kneading shaft mounted off centre;

- b. Continuous mixers having:
  1. Two or more mixing/kneading shafts; **and**
  2. Capability to open the mixing chamber.
2. The following equipment is included in 6005.b. above:
  - a. Equipment for the production of atomized or spherical metallic powder in a controlled environment;
  - b. Fluid energy mills for grinding or milling ammonium perchlorate, RDX, HMX.

**6006. Equipment, "technical data" and procedures for the production of structural composites "usable in" the systems in Item 6001, 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 fibers can be coordinated and programmed in three or more axes, designed to fabricate composite structures or laminates from fibrous or filamentary materials, and coordinating and programming controls;
- b. Tape-laying machines of which the motions for positioning and laying tape and sheets can be coordinated and programmed in two or more axes, designed for the manufacture of composite airframes and missile structures;
- c. Multi-directional, multi-dimensional weaving machines or interlacing machines, including adapters and modification kits for weaving, interlacing or braiding fibres to manufacture composite structures, except textile machinery not modified for the above end uses;
- d. Equipment designed or modified for the production of fibrous or filamentary materials, as follows:
  1. Equipment for converting polymeric fibers (such as polyacrylonitrile, rayon or polycarbosilane) including special provision to strain the fibre during heating;
  2. Equipment for the vapour deposition of elements or compounds on heated filament substrates; **and**
  3. Equipment for the wet-spinning of refractory ceramics (such as aluminum oxide);
- e. Equipment designed or modified for special fibre surface treatment or for producing prepregs and preforms;
- f. Technical data (including processing conditions) and procedures for the regulation of temperature, pressures or atmosphere in autoclaves or hydroclaves when used for the production of composites or partially precessed composites.

**Notes to Item 6006:**

1. Examples or components and accessories for the machines covered by this entry are moulds, mandrels, dies, fixtures and tooling for the preform pressing, curing, casting, sintering or bonding of composite structures, laminates and manufactures thereof.
2. Equipment covered by sub-item 6006.e includes but is not limited to rollers, tension stretchers, coating equipment, cutting equipment and clicker dies.

**6007. Pyrolytic deposition and densification equipment and "technology", as follows:**

- a. "Technology" for producing pyrolytically derived materials formed on a mould, mandrel or other substrate from precursor gases which decompose in the 1,300°C to 2,900°C temperature range at pressures of 130 Pa (1mm Hg) to 20 kPa (150mm Hg) including technology for the composition or precursor gases, flow-rates, and process control schedules and parameters;
- b. Specially designed nozzles for the above processes;
- c. Equipment and process controls, and specially designed software therefor, designed or modified for densification and pyrolysis of structural composite rocket nozzles and reentry vehicle nose tips.

**Notes to Item 6007:**

1. Equipment included under 6007.c. above are isostatic presses having all of the following characteristics:
  - a. Maximum working pressure of 69 MPa (10,000 psi) or greater;
  - b. Designed to achieve and maintain a controlled thermal environment of 600°C or greater; **and**
  - c. Possessing a chamber cavity with an inside diameter of 254 mm (10 inches) or greater.
2. Equipment included under 6007.c. above are chemical vapour deposition furnaces designed or modified for the densification of carbon-carbon composites.

**6008. Structural materials "usable in" the systems in Item 6001, as follows:**

- a. Composite structures, laminates, and manufactures thereof, specially designed for use in systems in Item 6001 and in subsystems in Item 6002, and resin impregnated fibre prepregs and metal coated fibre preforms thereof, made either with organic matrix or metal matrix utilizing fibrous or filamentary reinforcements having a specific tensile strength greater than  $7.62 \times 10^4$  m ( $3 \times 10^6$  inches) and a specific modulus greater than  $3.18 \times 10^6$  m ( $1.25 \times 10^8$  inches);
- b. Resaturated pyrolyzed (i.e. carbon-carbon) materials designed for rocket systems;
- c. Fine grain recrystallized bulk graphites (with a bulk density of at least 1.72 g/cc measured at 15°C) and having a particle size of  $100 \times 10^{-6}$  m (100 microns) or less, a pyrolytic, or fibrous reinforced graphites useable for rocket nozzles and reentry vehicle nose tips;
- d. Ceramic composite materials (dielectric constant less than 6 at frequencies from 100 Hz to 10,000 MHz) for use in missile radomes, and bulk machinable silicon-carbide reinforced unfired ceramic useable for nose tips;
- e. Tungsten, molybdenum and alloys of these metals in the form of uniform spherical or atomized particles of 500 micrometer diameter or less with a purity of 97 percent or higher of fabrication of rocket motor components: i.e. heat shields, nozzle substrates, nozzle throats, and thrust factor control surfaces;
- f. Maraging steels (steels generally characterized by high nickel, very low carbon content and the use of substitutional elements or precipitates to produce age-hardening) having an Ultimate Tensile Strength of  $1.5 \times 10^9$  Pa or greater, measured at 20°C.

**Note to Item 6008:**

1. Maraging steels are only covered by 6008.f. above for the purpose of this group in the form of sheet, plate or tubing with a wall or plate thickness equal to or less than 5.0 mm (0.2 inch).
2. The only resin impregnated fibre prepregs specified in a. above are those using resins with a glass transition temperature  $9T_g$  after cure, exceeding 145°C as determined by ASTM D4065 or national equivalents.

**6009. Instrumentation, navigation and direction finding equipment and systems, and associated production and test equipment, as follows, and specially designed components and software therefor:**

- a. Integrated flight instrument systems, which include gyrostabilizers or automatic pilots and integration software therefor, designed or modified for use in the systems in Item 6001;
- b. Gyro-astro compasses and other devices which derive position or orientation by means of automatically tracking celestial bodies or satellites;
- c. Accelerometers with a threshold of 0.05 g or less, or a linearity error within 0.25 percent of full scale output or both, which are designed for use in inertial navigation systems or in guidance systems of all types;
- d. All types of gyros usable in the systems in Item 6001, with a rated drift rate stability of less than 0.5 degree (1 sigma or rms) per hour in a 1 g environment;
- e. Continuous output accelerometers or gyros of any type, specified to function at acceleration levels greater than 100 g;
- f. Inertial or other equipment using accelerometers described by subitems 6009.c. and e. above or gyros described by subitems 6009.d. and e. above, and systems incorporating such equipment, and specially designed integration software therefor;
- g. Specially designed test, calibration, and alignment equipment, and "production equipment" for the above, including the following:
  1. For laser gyro equipment, the following equipment used to characterize mirrors, having the threshold accuracy shown or better:
    - a. Scatterometer (10 ppm);
    - b. Reflectometer (50 ppm);
    - c. Profilometer (5 Angstroms);
  2. For other inertial equipment:
    - a. Inertial Measurement Unit (IMU Module);
    - b. IMU Platform Tester;
    - c. IMU Stable Element Handling Fixture;
    - d. IMU Platform Balance Fixture;
    - e. Gyro Tuning Test Station;
    - f. Gyro Dynamic Balance Station;
    - g. Gyro Run-In/Motor Test Station;
    - h. Gyro Evacuation and Filling Station;
    - i. Centrifuge Fixture for Gyro Bearings;

- j. Accelerometer Axis Align Station;
- k. Accelerometer Test Station.

**Notes to Item 6009:**

1. Governments may permit the shipment of Items 6009.a. through f. exported as part of a manned aircraft, satellite, land vehicle or marine vessel or in quantities appropriate for replacement parts for such applications.
2. In subitem 6009.d.:
  - a. Drift rate is defined as the time rate of output deviation from the desired output. It consists of random and systematic components and is expressed as an equivalent angular displacement per unit time with respect to inertial space;
  - b. Stability is defined as standard deviation (1 sigma) of the variation of a particular parameter from its calibrated value measured under stable temperature conditions. This can be expressed as a function of time.
3. Accelerometers which are specially designed and developed as Measurement While Drilling (MWD) sensors for use in downhole well service operations are not specified in Item 6009.c.

**6010. Flight control systems and "technology", as follows: "designed or modified" for the systems in Item 6001 as well as the specially designed test, calibration, and alignment equipment therefor:**

- a. Hydraulic, mechanical, electro-optical, or electro-mechanical flight control systems (including fly-by-wire systems);
- b. Attitude control equipment;
- c. Design technology for integration of air vehicle fuselage, propulsion system and lifting control surfaces to optimize aerodynamic performance throughout the flight regime of an unmanned air vehicle;
- d. Design technology for integration of the flight control, guidance, and propulsion data into a flight management system for optimization of rocket system trajectory.

**Note to Item 6010:**

Governments may permit the shipment of sub-items 6010.a. and b. equipment exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.

**6011. Avionics equipment, "technology" and components, as follows: "designed or modified" for use in the systems in Item 6001 and specially designed software therefor:**

- a. Radar and laser radar systems, including altimeters;
- b. Passive sensors for determining bearings to specific electromagnetic sources (direction finding equipment) or terrain characteristics;
- c. Global Positioning System (GPS) or similar satellite receivers:
  1. Capable of providing navigation information under the following operational conditions:
    - a. At speeds in excess of 515 m/sec (1,000 nautical miles/hour); and
    - b. At altitudes in excess of 18 km (60,000 feet); or
  2. Designed or modified for use with unmanned air vehicles covered by Item 6001;
- d. Electronic assemblies and components specially designed for military use and operation at temperatures in excess of 125°C;
- e. Design technology for protection of avionics and electrical subsystems against electromagnetic pulse (EMP) and electromagnetic interference (EMI) hazards from external sources, as follows:
  1. Design technology for shielding systems;
  2. Design technology for the configuration of hardened electrical circuits and subsystems;
  3. Determination of hardening criteria for the above.

**Notes to Item 6011:**

1. Governments may permit the shipment of equipment exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.
2. Examples of equipment included in this Item:
  - a. Terrain contour mapping equipment;
  - b. Scene mapping and correlation (both digital and analog) equipment;
  - c. Doppler navigation radar equipment;
  - d. Passive interferometer equipment;
  - e. Imaging sensor equipment (both active and passive);

3. In subitem 6011.a, laser radar systems embody specialized transmission, scanning, receiving and signal processing techniques for utilization of lasers for echo ranging, direction finding and discrimination of targets by location, radial speed and body reflection characteristics.

**6012. Launch support equipment, facilities and software for the systems in Item 6001, as follows:**

- a. Apparatus and devices designed or modified for the handling, control, activation and launching of the systems in Item 6001;
- b. Vehicles designed or modified for the transport, handling, control, activation and launching of the systems in Item 6001;
- c. Gravity meters (gravimeters), gravity gradiometers, and specially designed components therefor, designed or modified for airborne or marine use, and having a static or operational accuracy of  $7 \times 10^{-6}$  m/sec<sup>2</sup> (0.7 milligal) or better, with a time to steady-state registration of two minutes or less;
- d. Telemetry and telecontrol equipment usable for unmanned air vehicles or rocket systems;
- e. Precision tracking systems:
  1. Tracking systems which use a code translator installed on the rocket or unmanned air vehicle in conjunction with either surface or airborne references or navigation satellite systems to provide real-time measurements of in-flight position and velocity;
  2. Range instrumentation radars including associated optical-infrared trackers and the specially designed software therefor with all of the following capabilities:
    - a. angular resolution better than 3 milli-radians (0.5 mils);
    - b. range of 30 km or greater with a range resolution better than 10 meters RMS; **and**
    - c. velocity resolution better than 3 meters per second;
  3. Software which processes, post-flight, recorded data, enabling determination of vehicle position throughout its flight path.

**Note to Item 6012:**

Sub-item 6012.d. does not embargo equipment specially designed to be used for remote control of toys such as model planes.

**6013. Analog computers, digital computers, or digital differential analyzers "designed or modified" for use in the systems in Item 6001 having either of the following characteristics:**

- a. Rated for continuous operation at temperatures from below minus 45°C to above plus 55°C; **or**
- b. Designed as ruggedized or "radiation hardened".

**Note to Item 6013:**

Governments may permit the shipment of equipment exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.

**6014. Analog-to-digital converters, usable in the systems in Item 6001 having either of the following characteristics:**

- a. Designed to meet military specifications for ruggedized equipment; **or**
- b. Designed or modified for military use; and being one of the following types:
  1. Analog-to-digital converter "microcircuits", which are "radiation-hardened" or have all of the following characteristics:
    - a. Having a resolution of 8 bits or more;
    - b. Rated for operation in the temperature range from below minus 54°C to above plus 125°C; **and**
    - c. Hermetically sealed.
  2. Electrical input type analog-to-digital converter printed circuit boards or modules, with all of the following characteristics:
    - a. Having a resolution of 8 bits or more;
    - b. Rated for operation in the temperature range from below minus 45°C to above plus 55°C; **and**
    - c. Incorporating "microcircuits" listed in 6014.b.1, above.

**6015. Test facilities and test equipment usable for the systems in Item 6001 and Item 6002, as follows, and specially designed software therefor:**

- a. Vibration test systems and components therefor, the following:
  1. Vibration test systems employing feedback or closed loop techniques and incorporating a digital controller, capable of vibrating a system at 10 g RMS or more over the entire range 20 Hz and 2,000 Hz and imparting forces of 50 kN (11,250 lbs), measured "bare table", or greater;
  2. Digital controllers, combined with specially designed vibration test software, with a real-time bandwidth greater than 5 kHz and designed for use with vibration test systems in (1) above;
  3. Vibration thrusters (shaker units), with or without associated amplifiers, capable of imparting a force of 50kN (11,250 lbs), measured "bare table", or greater, and usable in vibration test systems in (1) above;
  4. test piece support structures and electronic units designed to combine multiple shaker units into a complete shaker system capable of providing an effective combined force of 50kN, measured "bare table", or greater, and usable in vibration test systems in (1) above.
- b. Wind-tunnels for speeds of Mach 0.9 or more;
- c. Test benches/stands which have the capacity to handle solid or liquid propellant rockets or rocket motors of more than 90 kN (20,000 lbs) of thrust, or which are capable of simultaneously measuring the three axial thrust components;
- d. Environmental chambers and anechoic chambers capable of simulating the following flight conditions:
  1. Altitude of 15,000 meters or greater; or
  2. Temperature of at least minus 50°C to plus 125°C; and either
  3. Vibration environments of 10 g RMS or greater between 20 Hz and 2,000 Hz imparting forces of 5 kN or greater for environmental chambers; or
  4. Acoustic environments at an overall sound pressure level of 140 dB or greater (referenced to  $2 \times 10^{-5}$  N per square meter) or with a rated power output of 4 kiloWatts or greater, for anechoic chambers;
- e. Accelerators capable of delivering electromagnetic radiation produced by "bremsstrahlung" from accelerated electrons of 2 MeV or greater, and systems containing these accelerators.

**Note:**

1. The above equipment does not include that specially designed for medical purposes.
2. In 6015.a., the term "digital control" refers to equipment, the functions of which are, partly or entirely, automatically controlled by stored and digitally coded electrical signals.

**6016. "Specially designed" software, or "specially designed" software with related specially designed hybrid (combined analog/digital) computers, for modeling, simulation, or design integration of the systems in Item 6001 and Item 6002.**

**Note to Item 6016:**

The modeling includes in particular the aerodynamic and thermodynamic analysis of the systems.

**6017. Materials, devices, and "specially designed" software for reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures (i.e. stealth technology), for applications usable for the systems in Item 6001 and Item 6002, for example:**

- a. Structural materials and coatings specially designed for reduced radar reflectivity;
- b. Coatings, including paints, specially designed for reduced or tailored reflectivity or emissivity in the microwave, infrared or ultraviolet spectra, except when specially used for thermal control of satellites;
- c. Specially designed software or databases for analysis of signature reduction;
- d. Specially designed radar cross section measurement systems.

**6018. Devices for use in protecting rocket systems and unmanned air vehicles against nuclear effects (e.g. Electromagnetic Pulse (EMP), X-rays, combined blast and thermal effects), and usable for the systems in Item 6001, as follows:**

- a. "Radiation Hardened" microcircuits and detectors;
- b. Radomes designed to withstand a combined thermal shock greater than 100 cal/sq cm accompanied by a peak over pressure of greater than 50 kPa (7 pounds per square inch).

**Note:**

In 6018.a., a detector is defined as a mechanical, electrical, optical or chemical device that automatically identifies and records, or registers a stimulus such as an environmental change in pressure or temperature, an electrical or electromagnetic signal or radiation from a radioactive material.

**6019. Complete rocket systems (including ballistic missile systems, space launch vehicles and sounding rockets) and unmanned air vehicles (including cruise missile systems, target drones and reconnaissance drones), not covered in Item 6001, capable of a maximum range equal or superior to 300 km.**

**6020. Complete subsystems as follows, usable in systems in Item 6019, but not in systems in Item 6001, as well as specially designed "production facilities" and "production equipment" therefor:**

- a. Individual rocket stages
- b. Solid or liquid propellant rocket engines, having a total impulse capacity of  $8.41 \times 10^5$  Ns ( $1.91 \times 10^5$  lb.s) or greater, but less than  $1.1 \times 10^6$  Ns ( $2.5 \times 10^5$  lbs).

## Group 6 Definitions

### "Basic scientific research"

Experimental or theoretical work undertaken principally to acquire new knowledge of the fundamental principles of phenomena or observable facts, not primarily directed towards a specific practical aim or objective.

### "Designed or Modified"

Equipment, part, components or software which, as a result of "development", or modification, have specified properties that make them fit for a particular application. "Designed or Modified" equipment, parts, components or software can be used for other applications. For example, a titanium coated pump designed for a missile may be used with corrosive fluids other than propellants.

### "Development"

It is related to all stages prior to serial production, such as: design, design research, design analyses, design concepts, assembly and testing of prototypes, pilot production schemes, design data, process of transforming design data into a product, configuration design, integration design, layouts.

### "In the public domain"

Means "technology" or "software" which has been made available without restrictions upon its further dissemination.

N.B.:

Copyright restrictions do not remove "technology" or "software" from being "in the public domain".

### "Microcircuit"

A device in which a number of passive and/or active elements are considered as indivisibly associated on or within a continuous structure to perform the function of a circuit.

### "Production"

Means all production stages, such as: product engineering, manufacture, integration, assembly (mounting), inspection, testing, quality assurance.

### "Production facilities"

Equipment and specially designed software therefor integrated into installations for "development" or for one or more phases of "production".

### "Radiation Hardened"

Components or equipment capable of withstanding radiation levels which meet or exceed a total irradiation dose of  $5 \times 10^5$  rads (Si).

### "Software"

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

### "Specially Designed"

Equipment, parts, components or software which, as a result of "development" have unique properties that distinguish them for certain predetermined purposes. For example, a piece of equipment that is "specially designed" for use in a missile will only be considered so if it has no other function or use. Similarly, a piece of manufacturing equipment that is "specially designed" to produce a certain type of component will only be considered such if it is not capable of producing other types of components.

### "Technical assistance"

May take forms, such as: instruction, skills, training, working knowledge, consulting services.

N.B.:

"Technical assistance" may involve transfer of "technical data".

### "Technical data"

May take forms such as blueprints, plans, diagrams, models, formulae, tables, engineering designs and specifications, manuals and instructions written or recorded on other media or devices such as disk, tape, read-only memories.

### "Technology"

Specific information necessary for the "development", "production" or "use" of a product. The information takes the form of "technical data" or "technical assistance". "Technology" includes "software", in any medium or form, "specially designed" to facilitate the "development", "production" or "use" of items embargoed in this group. "Technology" also includes "software", in any medium or form, which is "specially designed" and incorporated in any items embargoed in this group.

### "Use"

Operation, installation (including on-site installation), maintenance (checking), repair, overhaul and refurbishing.

### "Usable In" or "Capable Of"

Equipment, parts, components or software which are suitable for a particular purpose. There is no need for the equipment, parts, components or software to have been configured, modified or specified for the particular purpose. For example, any military specification memory circuit would be "capable of" operation in a guidance system.

## Group 7 – Chemical and Biological Weapons Non-Proliferation

The definitions set out on page 76 of this guide apply in respect to this Group.

### 7000. The export of 'technology', including licenses, directly associated with CW agents, precursors and dual-use equipment items listed below, is controlled.

Controls do not apply to that 'technology' which is the minimum necessary for the installation, operation, maintenance, and repair of those products for which the export has been authorized.

Controls do not apply to information 'in the public domain' or to 'basic scientific research'.

### 7011. Chemical Weapon Agent Precursor Chemicals, as follows:

1. thiodiglycol, 111-48-8;
2. phosphorus oxychloride, 10025-87-3;
3. dimethyl methylphosphonate, 756-79-6;
4. methyl phosphonyl difluoride, 676-99-3;
5. methyl phosphonyl dichloride, 676-97-1;
6. dimethyl phosphite, 868-85-9;
7. phosphorus trichloride, 7719-12-2;
8. trimethyl phosphite, 121-45-9;
9. thionyl chloride, 7719-09-7;
10. 3-hydroxy-1-methylpiperidine, 3554-74-3;
11. N,N-diisopropyl-β-aminoethyl chloride, 96-79-7;
12. N,N-diisopropyl-β-aminoethane thiol, 5842-07-9;
13. 3-quinuclidinol, 1619-34-7;
14. potassium fluoride, 7789-23-3;
15. 2-chloroethanol, 107-07-3;
16. dimethylamine, 124-40-3;
17. diethyl ethylphosphonate, 78-38-6;
18. diethyl-N,N-dimethylphosphoramidate, 2404-03-7;
19. diethyl phosphite, 762-04-9;
20. dimethylamine hydrochloride, 506-59-2;
21. ethyl phosphinyl dichloride, 1498-40-4;
22. ethyl phosphonyl dichloride, 1066-50-8;
23. ethyl phosphonyl difluoride, 753-98-0;
24. hydrogen fluoride, 7664-39-3;
25. methyl benzilate, 76-89-1;
26. methyl phosphinyl dichloride, 676-83-5;
27. N, N-diisopropyl-β-amino ethanol, 986-80-0;
28. pinacolyl alcohol, 464-07-3;
29. QL(o-ethyl-2- diisopropylaminoethyl methylphosphonite, 57856-11-8;
30. triethyl phosphite, 122-52-1;

31. arsenic trichloride, 7784-34-1;
32. benzoic acid (2,2-diphenyl-2-hydroxyacetic acid) (2,2-diphenyl glycolic acid), 76-93-7;
33. diethyl methylphosphonite, 15715-41-0;
34. dimethyl ethylphosphonate, 6163-75-3;
35. ethyl phosphinyl difluoride (ethyl phosphorous difluoride), 430-78-4;
36. methyl phosphinyl difluoride (methyl Phosphorous difluoride), 753-59-3;
37. 3-quinuclidone, 3731-38-2;
38. phosphorus pentachloride, 10026-13-8;
39. pinacolone (3,3-dimethyl-2-butanone), 75-97-8;
40. potassium cyanide, 151-50-8;
41. potassium hydrogen fluoride (potassium bifluoride), 7789-29-9;
42. ammonium hydrogen fluoride (ammonium bifluoride), 1341-49-7;
43. sodium bifluoride (sodium hydrogen fluoride), 7681-49-4;
44. sodium fluoride, 1333-83-1;
45. sodium cyanide, 143-33-9;
46. tri-ethanolamine, 102-71-6;
47. phosphorous pentasulphide, 1314-80-3;
48. di-isopropylamine, 108-18-9;
49. diethylaminoethanol, 100-37-8; and
50. sodium sulphide, 1313-82-2.
51. sulphur monochloride, 10025-67-9
52. sulphur dichloride, 10545-99-0
53. triethanolamine hydrochloride, 637-39-8
54. N,N-diisopropyl-2-aminoethyl chloride hydrochloride, 4261-68-1

#### Note:

1. In Item 7011 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. Chemical mixtures containing any of the chemicals included in item 7011 are also covered by Item 7011, except when the chemical is merely an impurity that was not intentionally added or is a normal ingredient in consumer goods intended for retail sales.
3. Chemical compounds created with any chemicals listed in Item 7011 are not covered in Item 7011 unless the compound itself is listed in Item 7011.

(Item 7011 applies to all destinations **except** Argentina, Australia, Austria, Belgium, Denmark, the Federal Republic of Germany, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.)

### 7012. Chemical Test, Inspection and Production Equipment, as follows:

1. Reaction Vessels, Reactors or Agitators, Storage Tanks, Containers or Receivers, Heat Exchangers or Condensers, Distillation or Absorption Columns, Valves, Multi-walled Piping, and, Pumps, as follows:
  - a. Reaction Vessels or Reactors, with or without agitators, with a total internal (geometric) volume greater than 0.1 m<sup>3</sup> (100 l) and less than 20 m<sup>3</sup> (20,000 l);
  - b. Agitators for use in reaction vessels or reactors listed in Item 7012.1.a.;
  - c. Storage Tanks, Containers or Receivers, with a total internal (geometric) volume greater than 0.1 m<sup>3</sup> (100 l);
  - d. Heat exchangers or Condensers with a heat transfer surface area of less than 20 m<sup>2</sup>;
  - e. Distillation or Absorption Columns of internal diameter greater than 0.1 m;

- f. Multiple-seal valves incorporating a leak detection port, bellows-seal valves, non-return (check) valves or diaphragm valves;
- g. Multi-walled Piping incorporating a leak detection port; or
- h. Multi-seal, canned drive, magnetic drive, bellows or diaphragm pumps, with manufacturer's specified maximum flow-rate greater than 0.6 m<sup>3</sup>/h, or vacuum pumps with the manufacturer's specified maximum flow-rate greater than 5 m<sup>3</sup>/h (under standard temperature (0° C) and pressure (101.30 kPa) conditions)

**Technical Note:**

Items listed in 7012.1.a. through h. are considered to be included in this item only if all surfaces of any of the items coming in direct contact with the chemical(s) being processed or contained are made from any of the following materials:

- 1. nickel or alloys with more than 40% nickel by weight;
  - 2. alloys with more than 25% nickel and 20% chromium by weight;
  - 3. fluoropolymers;
  - 4. glass or glass-lined (including vitrified or enamelled coating);
  - 5. graphite (applies only to heat exchangers, condensers, distillation and absorption columns, multi-walled piping and pumps);
  - 6. tantalum or tantalum alloys;
  - 7. titanium or titanium alloys;
  - 8. zirconium or zirconium alloys;
  - 9. ceramics (applies only to pumps); or
  - 10. ferrosilicon (applies only to pumps)
- 2. Remotely operated filling equipment in which all surfaces that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:
    - 1. nickel or alloys with more than 40% nickel by weight; or
    - 2. alloys with more than 25% nickel and 20% chromium by weight.
  - 3. Incinerators designed to destroy CW agents, AG-controlled precursors or chemical munitions, possessing all of the following characteristics:
    - a. specially designed waste supply systems
    - b. special handling facilities, and
    - c. average combustion chamber temperature greater than 1000 °C,

**Technical Note:**

Items listed in item 7012.3.a. through c. are considered to be included only if all surfaces in the waste supply system that come into direct contact with the waste products are made from or lined with any of the following materials:

- 1. nickel or alloys with more than 40% nickel by weight;
  - 2. alloys with more than 25% nickel and 20% chromium by weight; or
  - 3. ceramics.
- 4. Toxic gas monitoring systems and dedicated detectors
    - a. designed for continuous operation and useable for the detection of CW agents, AG-controlled precursors or organic compounds containing phosphorus, sulphur, fluorine or chlorine at concentrations of less than 0.3 mg/m<sup>3</sup>; or
    - b. designed for the detection of cholinesterase-inhibiting activity.

**Note:**

Governments may permit the shipment of equipment (identified in Item 7012) which is specially designed for use in civil applications such as food processing, pulp and paper processing, or water purification and is, by the nature of its design, inappropriate for use in storing, processing, producing or conducting and controlling the flow of chemical weapon agents or any of the precursors chemicals which are included in Item 7011 or Item 2007.

(Item 7012 applies to all destinations **except** Argentina, Australia, Austria, Belgium, Denmark, the Federal Republic of Germany, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.)

**7021. Biological Weapon Agents**

**1. Human pathogens**

- a. Viruses
  - 1. Chikungunya virus
  - 2. Congo-Crimean haemorrhagic fever virus
  - 3. Dengue fever virus
  - 4. Eastern equine encephalitis virus
  - 5. Ebola virus
  - 6. Hantaan virus
  - 7. Junin virus
  - 8. Lassa fever virus
  - 9. Lymphocytic choriomeningitis virus
  - 10. Machupo virus
  - 11. Marburg virus
  - 12. Monkey pox virus
  - 13. Rift Valley fever virus
  - 14. Tick-borne encephalitis virus (Russian Spring Summer encephalitis virus)
  - 15. Variola virus
  - 16. Venezuelan equine encephalitis virus
  - 17. Western equine encephalitis virus
  - 18. White pox
  - 19. Yellow fever virus
  - 20. Japanese encephalitis virus
- b. Rickettsiae
  - 1. Coxiella burnetii
  - 2. Rickettsiae quintana (Rochalimea quintana)
  - 3. Rickettsiae prowasecki
  - 4. Rickettsiae rickettsii
- c. Bacteria
  - 1. Bacillus anthracis
  - 2. Brucella abortus
  - 3. Brucella melitensis
  - 4. Brucella suis
  - 5. Chlamydia psittaci
  - 6. Clostridium botulinum
  - 7. Francisella tularensis
  - 8. Pseudomonas mallei
  - 9. Pseudomonas pseudomallei
  - 10. Salmonella typhi
  - 11. Shigella dysenteriae
  - 12. Vibrio cholerae
  - 13. Yersinia pestis

d. Genetically Modified Micro-Organisms

1. Genetically modified micro-organisms or genetic elements that contain nucleic acid sequences associated with pathogenicity and are derived from organisms in the above list of human pathogens.
2. Genetically modified micro-organisms or genetic elements that contain nucleic acid sequences coding for any of the human toxins in the list below.

e. Toxins

1. Botulinum toxins
2. Clostridium perfringens toxins
3. Conotoxin
4. Ricin
5. Saxitoxin
6. Shiga toxin
7. Staphylococcus aureus toxins
8. Tretodotoxin
9. Verotoxin
10. Microcystin (Cyanginosin)

## 2. Animal pathogens

a. Viruses

1. African swine fever virus
2. Avian influenza virus

**Note:**

This includes only those Avian influenza viruses of high pathogenicity as defined in EC Directive 92/40/EC:

- a. "Type A viruses with an IVPi (intravenous pathogenicity index) in 6 week old chickens of greater than 1.2; or
- b. Type A viruses H5 or H7 subtype for which nucleotide sequencing has demonstrated multiple basic amino acids at the cleavage site of haemagglutinin.

3. Bluetongue virus
4. Foot and mouth disease virus
5. Goat pox virus
6. Herpes virus (Aujeszky's disease)
7. Hog cholera virus (syn. swine fever virus)
8. Lyssa virus
9. Newcastle disease virus
10. Peste des petits ruminants virus
11. Porcine enterovirus type 9 (syn. swine vesicular disease virus)
12. Rinderpest virus
13. Sheep pox virus
14. Teschen disease virus
15. Vesicular stomatitis virus

b. Rickettsiae – None

c. Bacteria

1. Mycoplasma mycoides

d. Genetically modified micro-organisms or genetic elements that contain nucleic acid sequences associated with pathogenicity and are derived from organisms in the above list of animal pathogens.

## 3. Plant Pathogens

a. Virus – none

b. Rickettsiae – none

c. Bacteria

1. Xanthomonas albilineans
2. Xanthomonas campestris pv citri

d. Genetically modified micro-organisms or genetic elements that contain nucleic acid sequences associated with pathogenicity derived from the plant pathogens identified on this list.

e. Toxins – none

f. Fungi

1. Colletotrichum coffeanum var. virulans
2. Cochliobolus miyabeanus (Helminthosporium oryzae)
3. Microcyclus ulei (syn. Dothidella ulei)
4. Puccinia graminis (syn. Puccinia graminis f.sp. tritici)
5. Puccinia striiformis (syn. Puccinia glumarum)
6. Pyricularia grisea/Pyricularia oryzae

(Item 7021 applies to all destinations **except** Argentina, Australia, Austria, Belgium, Denmark, the Federal Republic of Germany, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.)

### 7022. Biological Test, Inspection and Production Equipment as follows:

1. Complete containment facilities at P3, P4 containment level.

**Technical Note:**

Complete containment facilities that meet the criteria for P3 or P4 (BL3, BL4, L3, L4, BSL3, BSL4) containment as specified in the WHO Laboratory Biosafety Manual (Geneva, 1993 - 2nd Edition)

2. Fermenters capable of cultivation of pathogenic micro-organisms, viruses or for toxin production, without the propagation of aerosols, and having all of the following characteristics:

- a. capacity equal to or greater than 300 litres;
- b. double or multiple sealing joints within the steam containment area; **and**
- c. capable of in-situ sterilization in a closed state.

**Technical Note:**

For the purposes of item 7022.2, sub-groups of fermenters include bioreactors, chemostats and continuous-flow systems.

3. Centrifugal separators capable of the continuous separation of pathogenic micro-organisms, without the propagation of aerosols, and having all of the following characteristics:

- a. flow rate greater than 100 litres/h;
- b. component of polished steel or titanium;
- c. double or multiple sealing joints within the steam containment area; **and**
- d. capable of in-situ steam sterilisation in a closed state.

**Technical Note:**

For the purposes of Item 7022.3, centrifugal separators include decanters.

4. Cross-flow filtration equipment designed for continuous separation of pathogenic micro-organisms, viruses, toxins and cell cultures without the propagation of aerosols, and having all of the following characteristics:

- a. equal to or greater than 5 square metres; **and**
- b. capable of in-situ sterilization.

5. Steam sterilizable freeze-drying equipment with a condenser capacity greater than 50 kg of ice in 24 hours and less than 1000 kg of ice in 24 hours.

6. Equipment that incorporates or is contained in P3 or P4 (BL3, BL4, L3, L4, BSL3, BSL4) containment housing, as follows:
  - a. Independently ventilated protective full or half suits; or
  - b. Class III biological safety cabinets or isolators with similar performance standards.
7. Aerosol inhalation chambers designed for aerosol challenge testing with pathogenic micro-organisms, viruses or toxins and having a capacity of 1 cubic meter or greater.

*(Item 7022 applies to all destinations except Argentina, Australia, Austria, Belgium, Denmark, the Federal Republic of Germany, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.)*

## Group 7 Definitions

### "Technology"

Specific information necessary for the 'development', 'production' or 'use' of a product. The information takes the form of 'technical data' or 'technical assistance'.

### "Basic scientific research"

Experimental or theoretical work undertaken principally to acquire new knowledge of the fundamental principles of phenomena or observable facts, not primarily directed towards a specific practical aim or objective.

### "Development"

Development is related to all phases before 'production' such as: design, design research, design analysis, design concepts, assembly of prototypes, pilot production schemes design data, process or transforming design data into a product, configuration design, integration design, layouts.

### "In the public domain"

In the public domain, as it applies herein, means technology that has been made available without restrictions upon its further dissemination. (copyright restrictions do not remove technology from being in the public domain)

### "Production"

'Production' means all production phases such as: construction, production engineering, manufacture, integration, assembly (mounting), inspection, testing, quality assurance.

## Group 8 – Chemicals for the Production of Illicit Drugs

### 8011. Chemicals in excess of the indicated quantities, as follows:

1. Ephedrine (1 kg);
2. Ergometrine (10 g);
3. Ergotamine (10 g);
4. Lysergic acid (10 g);
5. 1-phenyl-2-propanone (20 kg);
6. Pseudoephedrine (1 kg);
7. N-Acetylthranilic acid (40 kg); **and**
8. 3,4-Methylenedioxyphenyl-2-propanone (4 kg).

### 8021. Chemicals in excess of the indicated quantities, as follows:

1. Piperidine (0.5 kg);
2. Safrole (4 kg);
3. Isosafrole (4 kg);
4. Piperonal (4 kg);
5. Anthranilic acid (30 kg); **and**
6. Phenylacetic acid (1 kg).

### 8031. Chemicals in excess of the indicated quantities, as follows:

1. Acetone (2000 l);
2. Ethyl ether (2000 l);
3. Methyl ethyl ketone (2000 l);
4. Toluene (2000 l);
5. Potassium permanganate (500 kg);
6. Sulfuric acid (2000 l);
7. Hydrochloric acid (2000 l); **and**
8. Acetic anhydride (1000 l).

#### Note:

Mixtures of chemicals where at least one of the chemicals is not listed in Items 8011, 8021 or 8031 are not included in those Items provided that the mixture was not created solely to avoid inclusion.

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NOTES



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## HOW TO COMPLETE THE APPLICATION

**DATE:** Enter the date on which the application has been completed. (Top right hand corner).

**EXPORTER:** Indicate full name, street address, city, province, country, postal code, telephone number and name of the person that should be contacted regarding this application.

**APPLICANT:** Complete this area if the person applying for the individual export permit is different from the exporter, or if the exporter is a non-resident of Canada. **THE APPLICANT MUST BE A RESIDENT OF CANADA.** Print or type full name, street address, city, province, country, postal code, telephone number and the name of the person who becomes legally responsible for the use of the export permit, if issued.

**CONSIGNEE:** Insert the full name, street address, city and country of final destination. The country of final destination is the country in which the goods are to be consumed or finally remain. **MAXIMUM THREE CONSIGNEES PER APPLICATION.**

**CANADIAN PORT:** Indicate the Canadian Customs Port where the Customs entry form B-13 or equivalent export documentation covering the goods will be validated.

**PERCENTAGE OF U.S. CONTENT: COLUMN 1(A):** Specify what percentage of the total value of each good being exported is U.S. content as defined by ECL item 5400. If items vary in U.S. content, indicate the U.S. content for each item.

**COUNTRY OF ORIGIN:** Column 1(B): If not of U.S. origin, indicate the country of origin.

**ECL ITEM NO.:** Column 2: Indicate the Export Control List Item number which controls your goods proposed for export.

**COMMODITY CODE:** If known, please provide the Harmonized System (HS) code for each line item.

**DESCRIPTION:** Column 3: Describe the goods concerned in sufficient detail so as to disclose their true identity and avoid the use of trade names, generic names or general terms that do not adequately describe the goods. Where there is insufficient space on the application form, an annex may be attached. All annex documents that are submitted become part of the export permit. Each page of the annex should include the application I.D. number and be sequentially numbered.

**TOTAL QUANTITY:** Column 4: Specify the total quantity of each line item identified in the description column

**UNIT VALUE:** Column 5: Specify in Canadian dollars the selling price of each of the items listed.

**TOTAL VALUE:** Column 6: For each line item identified in the description column 3, specify in Canadian dollars the total value derived by multiplying column 4 and 5 for that line.

**APPROX. NET WEIGHT:** Column 7: Specify the total weight of each line item identified in the description column.

**TOTAL VALUE OF ALL GOODS PROPOSED FOR EXPORT:** Total column 6 and enter the total value of all goods to be exported in the space provided.

**IIC/EUC:** In certain instances International Import Certificates (IIC), End Use Certificates (EUC), etc., are required prior to issuance of an export permit. If you have included one of these documents with your application, please indicate by marking an X in the appropriate box.

**TECHNICAL INFORMATION/DESCRIPTION:** In order to determine if the goods are controlled, under what ECL item the goods are controlled, and at what level the goods are controlled, full technical specifications must accompany each application. Mark (x) the appropriate box if this information accompanies the application.

**PERMIT TO BE SENT TO/BY:** Indicate by marking the appropriate box who the export permit is to be returned to (i.e. exporter or applicant) and how the export permit is to be returned. **NOTE:** Export permits requested to be returned by courier are at the expense of the exporter/applicant, whichever the case may be

**CERTIFICATION:** The exporter or applicant must sign and date the application form.

**DEPARTMENTAL USE ONLY:** Do not complete or enter any information in the bottom part of this application which is indicated FOR

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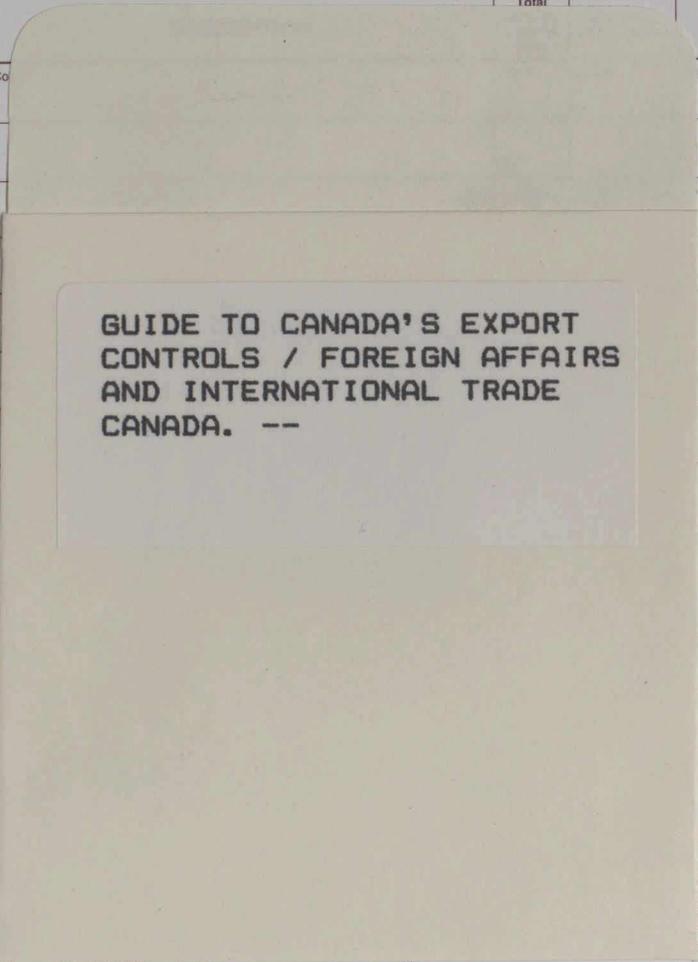
APPLICATION FOR PERMIT TO EXPORT GOODS / DEMANDE DE LICENCE D'EXPORTATION DE MARCHANDISES

Quote this Application I.D. Number for all Enquiries / Citer ce numéro pour toute demande de renseignements:

Date of Application / Date de la demande:

EXPORTER/EXPORTATEUR and APPLICANT (if other than exporter)/REQUÉRANT (si autre que l'exportateur) sections with fields for Name, Address, City, Province, Country, Telephone, and Facsimile.

Table with columns: % of U.S. / % des E.U., Country of origin / Pays d'origine, ECL Item No. / N° d'article de la LMEC, Commodity Code / Code de commodité, Total, Total Value / Valeur Totale (\$ Can), and Approx. Net Wgt. / Poids net approx. Rows 1-12.



THE TOTAL VALUE OF ALL GOODS PRODUCED / LA VALEUR TOTALE DE TOUTES LES MARCHANDISES PRODUITES

ADDITIONAL INFORMATION ATTACHED / RENSEIGNEMENTS COMPLÉMENTAIRES CI-JOINT section with checkboxes for IIC/EUC, CII/CUF, and Courrier Collect/Messagerie (port dû).

TESTATION / Attestation section: Attestation certifiée que les renseignements donnés sont exacts.

FOR DEPARTMENTAL USE ONLY - À USAGE DU MINISTÈRE SEULEMENT

PERMIT / LICENCE section with numbered conditions in English and French, Permit Number, Date of issue, Expiry Date, and File Number fields.

April 1994

# A Guide to Canada's Export Controls

*Additional copies of this guide and the form, "Application for permit to export goods" (FORM EXT-1042), can be obtained at the following locations:*

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### INTERNATIONAL TRADE CENTRE

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Vancouver, British Columbia  
V6B 5H8  
Fax: (604) 666-8330  
Tel: (604) 666-0434

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### INTERNATIONAL TRADE CENTRE

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Suite 540  
9700 Jasper Avenue  
Edmonton, Alberta  
T5J 4C3  
Fax: (403) 495-4507  
Tel: (403) 495-2944

## CALGARY

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## OTTAWA

### FOREIGN AFFAIRS AND INTERNATIONAL TRADE CANADA

EXPORT CONTROLS DIVISION  
125 Sussex Drive, C-4  
P.O. Box 481, Station A  
Ottawa, Ontario  
K1N 9K6  
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Tel: (613) 996-2387

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H4Z 1E8  
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Tel: (514) 283-8185

## MONCTON

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770 Main Street  
P.O. Box 1210  
Moncton, New Brunswick  
E1C 8P9  
Fax: (506) 851-6429  
Tel: (506) 851-6452

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B3J 2V9  
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Charlottetown,  
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C1A 7M8  
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Tel: (902) 566-7443

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### INTERNATIONAL TRADE CENTRE

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A1B 3R9  
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