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

A Guide To

CANADA'S EXPORT CONTROLS

APRIL 2002

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:

Telephone: (613) 996-2387
Facsimile: (613) 996-9933

MAILING ADDRESS:

Department of Foreign Affairs and
International Trade
Export Controls Division (EPE)
Lester B. Pearson Building
125 Sussex Drive - C-6
Ottawa, Ontario
K1A 0G2

FOR ENQUIRIES ON THE STATUS OF AN
EXPORT PERMIT APPLICATION:
Call (613) 996-2387 and quote your export permit application identification number.

This Guide is available on the departmental WEB Site:
http://www.dfait-maeci.gc.ca/~eicb/

Export questions can be submitted to email address:
ECL?@dfait-maeci.gc.ca

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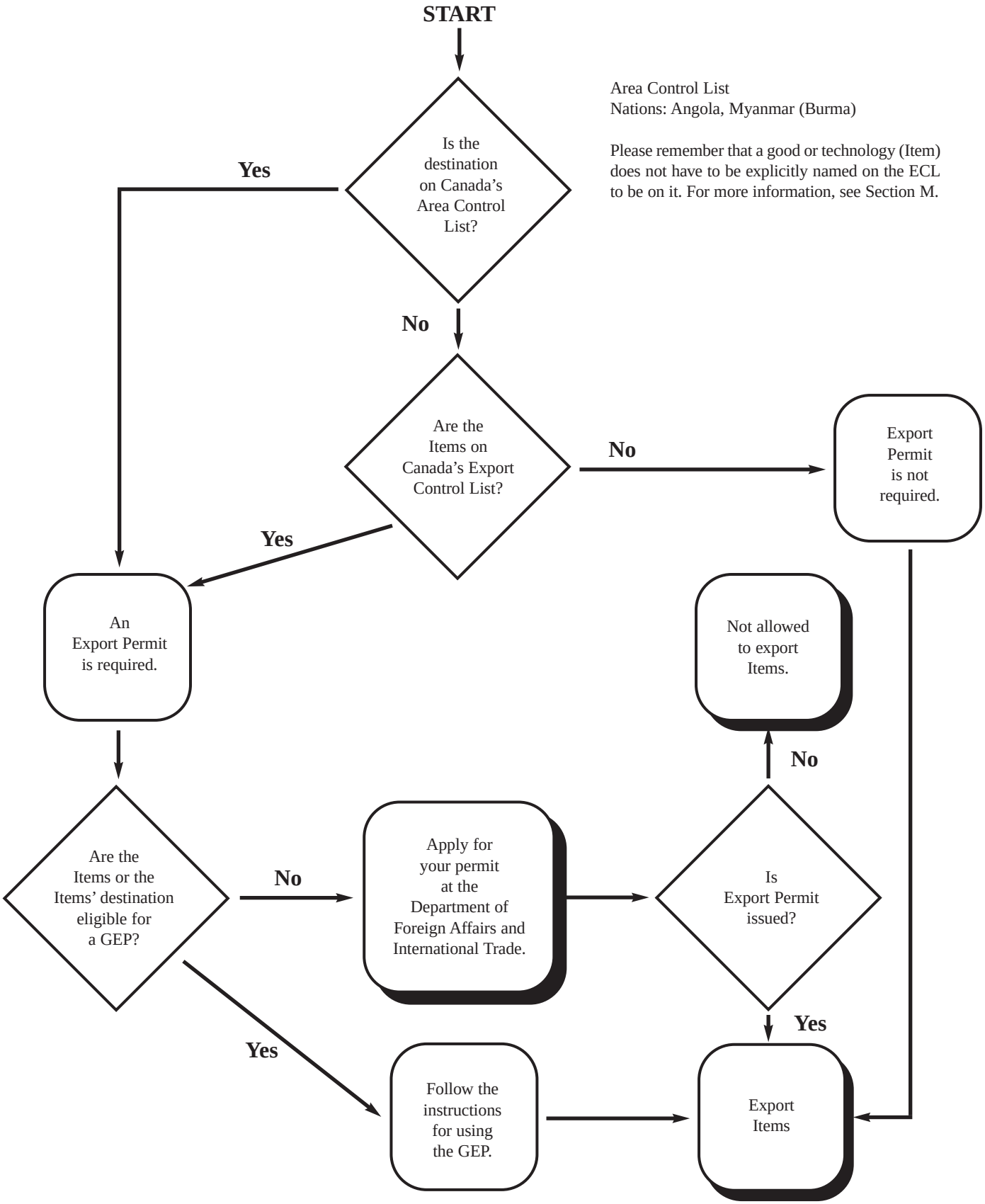


Area Control List
Nations: Angola, Myanmar (Burma)

Please remember that a good or technology (Item) does not have to be explicitly named on the ECL to be on it. For more information, see Section M.

Introduction

A. Do I Need An Export Permit?

This is the first question facing an exporter. Goods and technology of some categories, of certain origins, and going to some destinations, require that an exporter first obtain a federal export permit from the Export Controls Division (EPE) of the Department of Foreign Affairs and International Trade (DFAIT) before they can legally be exported. To help understand the decision process involved, please refer to the flow-chart on the opposite page.

What is an Export permit?

Under the *Export and Import Permits Act* (EIPA), the Minister of Foreign Affairs and International Trade may issue to any resident of Canada a permit to export goods and technology included in an *Export Control List* (ECL) or goods and technology to a country included in an *Area Control List* (ACL), subject to such terms and conditions as are described in the permit. The permit indicates among other things, the quantity, description and nature of the items to be exported as well as the final destination country and end-user. There are two types of permits: Individual Export Permits (IEP) or General Export Permits (GEP).

Export permits are required if goods and technology are:

Step 1: destined to a country on Canada's *Area Control List*;
Step 2: subject to a United Nations Security Council embargo/action;
Step 3: on Canada's *Export Control List*;
Step 4: of U.S. origin;
Step 5: destined to a chemical, biological or nuclear weapons, or missile application (Goods for Certain Uses);
Step 6: subject to export controls by other government departments/agencies; **or**
Step 7: subject to re-export controls by foreign governments.

Step 1: Goods and Technology Destined to Area Control List Countries

Regardless of being listed or not on the *Export Control List*, any goods or technology going to a country on the *Area Control List* (ACL) require a permit before they can be exported. At time of publication, the ACL included Angola and Myanmar (formerly Burma).

Step 2: Goods and Technology Subject to UN Security Council Embargo/Action

For any nation that is subject to a United Nations Security Council embargo, additional approvals may be required, e.g., all goods destined to Iraq (for a list of current sanctions refer to http://www.dfait-maeci.gc.ca/trade/sanctions-e.asp).

Step 3: The *Export Control List*

A variety of specific goods and technology, controlled by the Department of Foreign Affairs and International Trade (DFAIT) require permits for export, regardless of their destination. These goods and technology are found on the *Export Control List* (ECL), which is contained in this Guide. Most, but not all goods and technology are eligible for an exclusion to usual permit requirements if destined for end-use in the U.S. and its possessions (refer to Section D). The ECL is quite detailed, covering many products that Canada controls for various reasons. Section M provides some practical information on using the ECL.

Step 4: U.S. Origin Goods

Exporters should note that the export of all goods of U.S. origin as defined in ECL Item 5400, and regardless of their nature and destination, require permits (refer to Section E) if not captured elsewhere on the ECL. This is in recognition of the favourable permit/licence treatment accorded bilaterally on most controlled goods and technology. (See Step 7 below and Section E for details on exports of U.S. origin goods and technology contained elsewhere in the ECL.)

Step 5: Goods and Technology Destined to a Chemical, Biological or Nuclear Weapons, or Missile Application *(Goods for Certain Uses)*

In 2002, Canada implemented 'catch-all' controls that cover the export of any goods and technology not listed elsewhere on the ECL. ECL Item 5505 *Goods for Certain Uses* imposes a permit requirement on any goods and related technology if it is determined that the goods or technology are destined to an end-use or end-user involved in the development or production of chemical, biological or nuclear weapons or Weapons of Mass Destruction (WMD), or their missile delivery systems. Before exporting any goods or technology exporters must assure themselves that their export is not being transferred, directly or indirectly, to a WMD end-use/end-user. If in doubt, the exporter should contact the Export Controls Division for assistance (refer to inside front cover).

Step 6: Goods and Technology Subject to Export Controls by Other Government Departments/Agencies

Other controls may apply, for example: the Canadian Nuclear Safety Commission for nuclear/atomic items; Environment Canada for endangered species and hazardous waste; and Heritage Canada for cultural properties. Refer to Section F for a description of other departments/agencies which may possibly have export authorisation requirements. For more information about exporting requirements, please contact your local Canada Customs and Revenue Agency (CCRA) office or the responsible government department or agency. These can be found in the blue pages of your local telephone book under "Government of Canada".

Step 7: Goods and Technology Subject to Re-export Controls by Foreign Governments

Some countries, most notably the United States, impose re-export controls from another country on goods and technology that originated in, or were manufactured in their country. Under a bilateral agreement with the U.S., Canada has agreed to not issue Canadian export permits for goods or technology contained in ECL Groups 2 or 6, or ECL Item 5504, if the proposed export includes goods or technology of U.S. origin which are contained in ECL Groups 2 or 6, or ECL Item 5504, unless supported by a U.S. export authorisation (refer to Section E). If in doubt, exporters should contact the Export Controls Division or the original supplier in the country of origin/manufacture.

Summary

In the event none of the above circumstances applies (Steps 1 - 7), then an export permit from DFAIT is not required. However, it is the exporter's responsibility to keep abreast of any changes to Canada's export control regime that may affect their export requirements.

B. Why Do Export Controls Exist?

1. For some goods or technology, such as certain U.S. origin items, controls exist to fulfill Canada's bilateral obligations. However, most of Canada's export controls exist because Canada is a partner in multilateral or international agreements (e.g., Wassenaar Arrangement) designed to control and monitor the movement of strategic goods and technology. These international obligations are non-discretionary. These obligations include the control of military goods and technology, or goods and technology that could be used for developing or producing nuclear, chemical or biological weapons or their missile delivery systems. As examples, consider these two multilateral agreements and the items they control:

The Australia Group

- defines controls to prevent the proliferation and development of chemical and biological weapons.

Missile Technology Control Regime

- defines controls to prevent the proliferation of missile weapons systems and sub-systems capable of delivering chemical, biological or nuclear weapons.

2. Canada's export controls are not intended to hamper business. Rather, the regulations are designed to ensure that exports and transfers of certain goods and technology are in keeping with the strategic interests of Canada or its allies and are consistent with Canada's bilateral or multilateral commitments. Considering the volatility of the international political environment - and the speed with which new technology is being developed - it is clear that these controls are necessary to safeguard Canadian security, political and international interests.

3. While strategic concerns are important in overall export controls, what many people fail to realize is that Canadian export controls are also designed to protect trade interests. For example, by ensuring that controlled items are covered by appropriate end-use assurances from the recipient country, export controls provide a measure of assurance that the items are not diverted to unacceptable uses or destinations resulting in embarrassment to Canada or the exporting company.

4. If exporters have questions regarding the international agreements as identified in Section L, please contact the Export Controls Division. The telephone/facsimile numbers and mailing and email addresses are on the inside front cover of this Guide.

C. How Do I Obtain An Export Permit?

1. In almost all cases, exporters apply for individual export permits through the Export Controls Division (EPE). To receive a permit, an exporter must first complete an application form and send it - either by mail or courier - to EPE for processing. The form required is form EXT-1042, *Application for Permit to Export Goods*. These forms can be mailed to you from EPE in Ottawa, or can be obtained from any of the International Trade Centre offices listed on the back cover of this booklet, or from most Customs offices. On the inside back cover of this booklet you will find a sample of the form. As well, the mailing and courier addresses for EPE are located on the inside front cover.

2. On the reverse side of the export permit application form is detailed information on how to complete the form. Exporters should familiarize themselves with the elements that need to be included when completing the application in order to avoid any unnecessary delays in processing. First time business applicants should include their GST number.

3. Every effort will be made to process a permit application quickly. For some goods and technology the processing time can be as short as 10 working days from receipt in the Export Controls Division. Permit applications for certain other goods and technology, however, such as military or strategic goods going to destinations other than NATO partners or Open Policy Countries (OPC*), may take longer to process. In most cases EPE consults with other government departments and, possibly, seeks ministerial approval. This may take up to six weeks to process, and in some cases longer. Exporters who would like EPE to courier approved permits back to them must assume the courier costs and provide their courier account number on their export permit application.
   Open Policy Countries are essentially those like-minded countries that belong to the same export control regimes as Canada and which have effective export controls.

4. An approved application to export goods and technology will be assigned a unique permit number. This will be featured prominently in the lower right-hand corner of the form. Canada Customs and Revenue Agency (CCRA) requires that the exporter record this permit number in the appropriate field of the Export Declaration (Form B-13A) and submit this Declaration to CCRA, together with the export permit, prior to exporting the goods or technology.

5. Export permits for goods and technology are subject to different maximum validity periods. The general guidelines are as follows:

   GROUP 1
   For non-Open Policy Countries (OPC) - two years;
   For OPC destinations - two years if there is no contract;
   For OPC destinations - up to five years if there is a contract (the permit would include all the goods and technology detailed in the contract to the end-users party to the contract).

   GROUP 2
   Items 2001 through 2004 - single shipment conditions to most destinations;
   Items 2005 through 2022 - two years if there is no contract or where the end-user is a commercial enterprise; up to five years to an OPC destination where the end-user is a government entity, or acting on behalf of a government.

   GROUP 3
   All Items - up to five years provided this is matched with a Canadian Nuclear Safety Commission (CNSC) licence.

   GROUP 4
   General Export Permit No. 27 (GEP 27) applies provided a CNSC licence has been obtained (refer to Section F).

   GROUP 5
   Item 5400 - two years;
   Item 5504 - treated like Group 1.
   Note: Some items in Group 5, e.g., logs or pulpwood, may have validity periods of less than one year. Extensions to these permits may be made on a case-by-case basis.

   GROUP 6
   All Items - two years.

   GROUP 7
   All Items - two years.

   GROUP 8
   Normally single shipment. GEP 26 applies for Items 8021 and 8031 to most destinations.

6. All export permits for military goods and technology in ECL Group 2 are issued on the condition that the reporting requirement noted on the permit is met. This report must detail the actual shipments of goods made against each export permit.

7. Reporting conditions may also apply to other items on the ECL. Exporters should examine their permit to determine whether or not any reporting conditions apply.

D. Do I Need A Permit for Exports To the United States?

Exports to the United States

Under a bilateral arrangement with the United States, export permits are not required for most ECL items when shipped to a final destination and for end-use in the U.S. If the ECL goods are only transiting the U.S. for export to other destinations, an export permit is required based on the country of final destination. However, all goods and technology in Groups 3 and 4, and some goods and technology in Groups 2, 5, 7 and 8 require an individual export permit even when the final destination is the U.S. (These are indicated under the rubric *all destinations* located within individual ECL Items). If uncertain contact the Export Controls Division.

E. Do I Need A Permit for the Export of U.S. Origin Goods or Technology?

Export of U.S. Origin Goods and Technology Controlled in the ECL (except ECL Item 5400)

1. The Government of the United States has traditionally controlled the export from other countries of goods and technology that had their origins in the United States and as such, imposes re-export controls. Exporters are cautioned that some U.S. origin goods and technology, including U.S. origin parts and components incorporated into a finished product, may be subject to U.S. re-export controls. If exporters are uncertain as what re-export controls, if any, might apply to their goods and technology, they should contact the Export Controls Division or the original U.S. supplier for guidance.

2. Exporters may be required to provide a copy of a validated U.S. export licence or verification that the specified goods may be exported to the specified country without the U.S. licence, prior to issuance of an individual export permit. Proof of U.S. re-export authorisation is required for goods, technology and components of U.S. origin which fall within ECL Group 2, ECL Group 6 or ECL Item 5504 before an export permit will be granted (refer to Section F and the *Export Permits Regulations*). In some cases, the U.S (or other supplier) may impose, as a condition of supplying certain goods and technology, a requirement that the Canadian purchaser seek re-export approval before exporting the goods and technology from Canada. This would be regardless of whether the goods and technology have been incorporated into a finished product in Canada.

Export of Goods of U.S. Origin Controlled by ECL Item 5400

3. Goods of U.S. origin as defined in ECL Item 5400, and not covered elsewhere in the ECL, are controlled for export from Canada. As this measure is designed to ensure Canada is not used as a diversionary route to circumvent U.S. embargoes, when the goods are destined for end-use in countries where no such embargo applies, exporters may invoke a General Export Permit (GEP). GEPs have several advantages and are administratively easy to use. They are discussed in greater detail in Section F of this Guide.

Export of Goods of U.S. Origin to Iran, Cuba, Libya, North Korea and Area Control List Countries

4. As noted above, all goods of U.S. origin defined under Item 5400 of the ECL require an export permit. If these goods are destined for end-use in Iran, Cuba, Libya or North Korea, or to any country on Canada's *Area Control List* (ACL), the exporter must apply to EPE for an individual export permit. In all other cases, *General Export Permit No. 12* is applicable. For more information, contact the Export Controls Division.

F. What Other Export Control Issues Should I Be Aware Of?

Automatic Firearms Country Control List (AFCCL)

1. In addition to the ECL and the ACL, certain additional export controls exist specifically for automatic firearms. These firearms may be exported only to countries with which Canada has intergovernmental defence, research, development and production arrangements. While new countries are added periodically and exporters should contact EPE to determine whether countries have been added, the current list of AFCCL countries are:

• Australia	• Denmark	• Italy	• Saudi Arabia	• United Kingdom
• Belgium	• France	• Netherlands	• Spain	• United States
• Botswana	• Germany	• Norway	• Sweden	

Fees for Export Permits (Group 5 only)

2. Under the authority of the *Export and Import Permits and Certificate Fees Order, 1995* (amended 1996) a fee is levied for each permit for most Group 5 Items except for ECL Items 5400, 5401, 5501, 5502, 5503, 5504 and 5505. All other Items in Group 5 are assessed a $14 administrative fee for each export permit application submitted. For softwood lumber under Item 5104 and 5105, a $9 fee is assessed if export permit applications are completed and submitted electronically. For more information about fee charges related to softwood lumber, please contact the Softwood Lumber Division at (613) 944-2167.

3. Money orders or cheques payable to the Receiver General for Canada are acceptable forms of payment, and must be included with the application for an export permit. Exporters who make frequent shipments may prefer to be placed on a monthly billing system. If the exporter would prefer to be billed monthly, rather than making advance payment for each individual permit, such requests should be submitted to:

   Director General
   Export and Import Controls Bureau (EPD)
   Department of Foreign Affairs and International Trade
   125 Sussex Drive
   Ottawa, ON K1A 0G2

General Export Permits (GEP)

4. General Export Permits (GEP) enable an exporter to export certain goods or technology which are subject to control to eligible destinations without the necessity of submitting individual export permit applications. A GEP is a valid export permit which is used to minimize the administrative burden for exporters and to streamline licensing procedures. By using a GEP, exporters do not have to apply to EPE for authorisation. Instead, when exporting goods listed on the ECL where a GEP applies, the exporter must cite the appropriate GEP number in the relevant box on the Customs Export Declaration (Form B13A). However, some GEPs contain conditions which must be adhered to in order to use them. In some cases, the use of a GEP is conditional on an exporter undertaking to report on actual volumes of exports or on specific final consignees made against the GEP.

5. GEPs are available for specific goods and technology, and specific destinations. For details on how to use a GEP, please contact the Export Controls Division or refer to the Internet site at: http:\\laws.justice.gc.ca/en/E-19/index.html for a current list of GEPs. The following is a list of GEPs in effect at time of printing :

   GEP 1: Export of Goods for Special and Personal Use
   GEP 3: Export of Consumable Stores Supplied to Vessels and Aircraft
   GEP 5: Export of Logs
   GEP 12: United States Origin Goods
   GEP 26: Industrial Chemicals
   GEP 27: Nuclear-related Dual-use Goods
   GEP 29: Eligible Industrial Goods
   GEP 30: Certain Industrial Goods to Eligible Countries and Territories
   GEP 31: Peanut Butter
   GEP 39: Mass-Market Cryptographic Software

Dual-controls for Nuclear and Atomic Energy Goods and Technology

6. In addition to the dual-controls imposed by DFAIT and the Canadian Nuclear Safety Commission (CNSC) for nuclear and nuclear-related items identified in Groups 3 and 4, CNSC also controls, under the *Nuclear Safety and Control Act* (NSCA), certain radioactive substances and isotopes which are deemed capable of releasing atomic energy or being required for the production, use or application of atomic energy.

7. Exporters of certain radioactive materials not identified in this Guide (e.g., radioactive isotopes), as well as exporters of goods and technology contained in Groups 3 and 4, require an export licence from the CNSC. Information relating to such controls may be obtained by contacting the Export Controls Division or the:

   Canadian Nuclear Safety Commission
   Office of International Affairs
   Non-Proliferation, Safeguards and Security Division
   P.O. Box 1046, Station B
   Ottawa, ON K1P 5S9
   Telephone: (613) 995-5894
   (800) 668-5284
   Facsimile: (613) 995-5086
   Website: www.cnsc.gc.ca

8. It should be noted that Group 3-related exports can only occur when export authorizations are obtained from both DFAIT and CNSC. In order to obtain such authorizations, an exporter shall submit an export permit application along with the appropriate supporting documents to the Export Controls Division, who will forward all pertinent information to the CNSC.

Narcotics, Controlled Drugs and Precursors

9. Controls on the export, import and internal trade in illicit drug precursors identified in Group 8, which are controlled pursuant to international agreements, are to be taken over by Health Canada under the *Controlled Drugs and Substances Act*, along with other drugs, controlled substances, and precursors already subject to their control. Please contact the Export Controls Division for further information.

10. Exporters of drugs, controlled substances, and precursors not identified in this Guide, can obtain information relating to such controls by contacting:

    Office of Controlled Substances
    Drug Strategy and Controlled Substances Program
    Healthy Environments and Consumer Safety Branch
    Health Canada
    3503D
    Ottawa, ON K1A 1B9
    Telephone: (613) 952-2177
    Facsimile: (613) 946-4224
    Http://www.h-sc.gc.ca/hecs-secs/hecs/dscs.htm

The Canadian National Authority for the Chemical Weapons Convention (CWC)

11. The Canadian National Authority (CNA) for the CWC is responsible for the collection and monitoring of Canadian data dealing with the importation of *Import Control List* Item number 74 chemicals and precursors, and the exportation of ECL Items 7001 through 7006. These items correspond to Schedules 1, 2 and 3 of the *Chemical Weapons Convention* (CWC). For further information see the Canadian National Authority website www.dfait-maeci.gc.ca/nndi- agency/cwc_index-e.asp or you may contact the CNA at 1-800-655-6229.

Other Government Departments

12. It is possible that export authorisations may be required for other goods from other government departments. These include, but are not limited to:

- Heritage Canada
- Health Canada
- Agriculture Canada
- Natural Resources Canada
- Canadian Wheat Board
- Environment Canada
- Fisheries and Oceans

The Controlled Goods Registration Programme (CGRP)

13. The Controlled Goods Registration Programme (CGRP) was established in 2001 under the *Defence Production Act* (DPA) and the *Controlled Goods Regulations* (CGR). Generally speaking, companies or persons having access to "controlled goods" as defined in the Schedule to the DPA, or who may possess, examine or transfer "controlled goods", including related technology within Canada, must be registered under the CGRP. The CGRP is administered by the Department of Public Works and Government Services Canada (PWGSC). Those goods and technology contained in ECL Groups 2* and 6, and ECL Item 5504 are "controlled goods". Exporters wishing to export "controlled goods" must be registered under the CGRP. If an exporter is not registered, an export permit application cannot be issued and the application will be held in abeyance until there is evidence that the exporter has registered. For information on the CGRP, please refer to the address and web site noted below.

    NOTE: For the purposes of the CGRP, Group 2 covers Items 2002 and 2004 through 2022 in their entirety. As well, under Item 2001, firearms with a calibre of 12.7mm or less are CGRP-controlled to the extent that they are "prohibited firearms" as defined in paragraph 84(1)(c) of the Criminal Code. Ammunition in Item 2003 is CGRP-controlled if the calibre is greater than 12.7mm.

Controlled Goods Registration Programme
Department of Public Works and Government Services Canada
7C1, Place du Portage, Phase III
Hull, Quebec
K1A 0S5
TEL: 1-866-333-2477
FAX: 1-819-956-2101
Email: ncr.cgrp@pwgsc.gc.ca
WebSite: www.cgrp.gc.ca

G. What Are The Export Permit Requirements For Forest Products?

1. A variety of export controls apply to Canadian forest products listed in Group 5 of the ECL. Remember that each export permit application for most non-strategic Group 5 Items, including forest products, entails a $14 processing fee. The processing fee for softwood lumber is $9. The following explains how exporters may obtain a permit to export a controlled forest product.

Logs and Pulpwood: All Provinces and Territories except British Columbia and the Yukon

2. Exporters are required to apply for an export permit for logs and pulpwood identified in ECL Group 5. The export permit application is to be sent directly to the Export Controls Division for processing.

Logs and Pulpwood: Originating from British Columbia

3. Details governing the export of logs from British Columbia are contained in Notice to Exporters No. 102, dated April 1, 1998. In summary, exporters who harvest logs from non-provisional Crown land or private lands must apply to the Export Controls Division on the form "Application to Advertise Logs on the B.C. Federal Bi-Weekly List" (EXT 1718). The application is the first step in the surplus test procedures. Applications are reviewed by the Federal Timber Export Advisory Committee (FTEAC). If it is determined that the logs are surplus to domestic requirements, the exporter will be informed to submit the form "Information on Logs in Support of Federal Application EXT 1042" (EXT 1719) together with the federal form EXT 1042 to the Export Controls Division. In those instances where logs are determined not to be surplus to domestic requirements, the exporter will be so informed.

4. Applications to export woodchips (pulpwood) must include a copy of the relevant *Order of the Lieutenant Governor in Council* issued by the Province of British Columbia. The approval or rejection of an application will be issued by DFAIT on behalf of the Minister of Foreign Affairs.

Logs and Pulpwood: Originating from Indian Reserves in British Columbia

5. For logs harvested from Indian Reserves and surrendered lands as defined in the *Indian Act* and *Indian Timber Regulations*, an applicant must submit the following documentation to the B.C. Ministry of Forests Provincial Regional Office:
   i) The federal form, "Information on Logs in Support of Federal Application EXT-1042" (EXT 1719);
   ii) Written Letter of Consent from the Department of Indian Affairs and Northern Development (DIAND);
   and
   iii) A stock scale in approved format.

6. The exporter must obtain a Written Letter of Consent by applying to DIAND in Vancouver. Once the Letter of Consent is issued by DIAND, it is sent to DFAIT with copies to the B.C. Ministry of Forests and the applicable Indian Band. For information contact:

   Department of Indian and Northern Affairs Canada
   Lands and Trust Services
   B.C. Region
   600 - 1138 Melville Street
   Vancouver, BC V6E 4S3
   Telephone: (604) 666-3931
   Facsimile: (604) 775-7149

7. Upon receipt of the documentation noted in paragraph 5 above, the Provincial Regional Office will return copies of the documents to the applicant. The applicant then applies to EPE for a federal export permit on form EXT 1042, "Application for Permit to Export Goods", and includes copies of all paragraph 5 documents.

8. Upon receipt of the documents noted in paragraph 7 above, the Export Controls Division will process the federal export permit application.

9. All logs are subject to, and must be available for, inspection by the B.C. Ministry of Forests. As well, all logs must be marked to identify their origin.

Logs and Pulpwood: Originating from the Yukon Territory

10. Exporters must apply to DFAIT for a normal export permit, and should allow 20 working days for processing. The delay in processing is because each case must be discussed among DFAIT, DIAND and the government of the Yukon. While other governments are involved, the approval or rejection of an export application will be made by EPE officials on behalf of the Minister. Any questions exporters have about their application are to be directed to EPE.

Softwood Lumber

11. Exports of softwood lumber require export permits if destined to the United States. For detailed information on these controls, please consult *Notices to Exporters No. 90, 92, 94, 98, 99, 102, 103, 106, 107, 108, 109, 110, 112, 114, 116, 118, 120, 121, 122, 125, 127, 128, 130 and 131 (Softwood Lumber Products)*. You may also wish to contact the Division responsible for softwood lumber export controls at:

    Softwood Lumber Division (EPS)
    Export and Import Controls Bureau
    Department of Foreign Affairs and International Trade
    125 Sussex Drive
    Ottawa, Ontario
    K1A 0G2
    TEL: (613) 944-2167
    FAX: (613) 944-2170
    Email: eps@dfait-maeci.gc.ca

H. What Administrative Procedures Are Applicable In The Processing Of Export Permits?

Advisory Opinions on Proposed Exports

1. It is common for exporters to request an opinion on the control status of goods and technology or on the prospect of receiving an export permit. This advice is provided wherever possible, but is not binding on the Minister. Therefore, exporters who want a binding decision are encouraged to apply for an export permit rather than requesting a written opinion.

Permits for Temporary Exports

2. Temporary permits are common for goods and technology exported for trade shows, exhibitions, demonstrations, geological surveying, and other events where the goods and technology will return to Canada. Exporters must apply for a permit in the normal manner and must note in the body of the application that they are asking for a permit for a temporary export. In granting a permit for a temporary export, EPE may place certain conditions on the export. These conditions may include:

   - adhering to the expiry date of the permit (normally 12 months);
   - ensuring the goods are properly supervised while abroad; **and**
   - providing proof that the goods are returned to Canada unchanged.

Multiple Shipments/Multiple Consignee Permits (Strategic/Other Goods)

3. In some cases, an exporter may use an export permit for more than one shipment to the consignee(s) specified on the export permit (a maximum of three consignees per permit in a single country) up to the value and quantity noted on the permit. This procedure applies to all goods and technology in Groups 1, 4, 5 (except ECL Items 5501, 5502, 5503, 5504 and 5505), 6 and 7.

Project Development Permits

4. Permits are required in all cases (except the U.S.) where technology, as defined in the ECL, is transferred abroad, regardless of the means of transmission. As a technology transfer is often required for issuing or responding to RFPs (Requests for Proposal), developing new products or other circumstances where no physical goods are exported, export permits should be sought to cover these contingences. Should this development work lead to a contract to supply goods, a permit valid for up to five years covering the deliverables (both goods and technology) of the contract may be issued in certain circumstances (refer to Section C).

Single Shipment Permits (Offensive Military Equipment)

5. As a general rule, export permits for military goods and technology falling under ECL Items 2001 through 2004, will be issued for a single shipment/single consignee only (refer to Section C). The export permit becomes invalid after the first shipment is made even if the shipment is only a partial one. Exporters must re-apply for a new export permit to cover any shortfall.

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

6. Other ECL Items in Group 2 not identified in paragraph 5 above, and all items in ECL Group 3 may be exported to a single consignee on a multiple shipment basis.

Export Permit Status Enquiries

7. Exporters may obtain information regarding the processing of their permit application by contacting the Export Controls Division at (613) 996-2387 and citing the red I.D. number located in the upper right-hand corner of the

export permit application. Please allow at least seven working days from time of mailing of the application before enquiring as to the status of the application.

Distribution and Retention of Permit Copies

8. Once the export permit has been approved, the exporter will receive an "Exporter's Copy" duly signed and authorized. This copy must be presented to Canada Customs and Revenue Agency (CCRA) at the port of export together with the appropriate shipping documents and Customs Export Declaration (Form B13A) prior to exportation. If the permit allows multiple shipments, then a photocopy of the "Exporter's Copy" must be submitted to Customs for subsequent shipments.

9. 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 is a General Export Permit (GEP) or an Individual Export Permit (IEP), for a period of seven years.

Amendments and Extensions of Export Permits

10. Minor amendments to permits may be allowed in limited circumstances. Requests to amend existing export permits 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 prior to the expiry date of the export permit.

11. Goods and technology not listed on the export permit, or destined to a consignee not listed on the export permit, may be subject to CCRA detention or seizure. Therefore, exporters must ensure that their export permit has been formally and legally amended before any export takes place.

Access to Information

12. As a general rule, under the *Privacy Act,* personal information in the possession of the Federal government cannot be disclosed without the consent of the individual concerned, notwithstanding the source of that information. Under the *Access to Information Act,* disclosure is the operative principle. However, before any information provided on an application is released to the public the applicant will be contacted. It is up to the applicant to demonstrate that its release would damage the applicant's commercial interests. Please refer to these Acts for more information or consult with the Access to Information and Privacy Protection Division (DCP) at the Department of Foreign Affairs ((613) 992-1425) to discuss any concerns.

I. What Supporting Documentation Is Required?

1. To a large extent, Canada and its major industrialized trading partners have harmonized their export control systems in order to prevent diversions or trans-shipments of controlled commodities for unauthorized end-uses or to unauthorized destinations. In some cases, government-to-government assurances from the end-user may be necessary. Applicants should keep such considerations in mind when planning their requirements for an export permit. Canada accepts various end-use assurances. These assurances appear in several internationally recognized forms:

   A. International Import Certificates (IIC);
   B. End-use Certificates (EUC), and/or Import Licences (IL);
   C. Delivery Verification Certificates (DV) (post-transaction);
   D. End-use Statements (EUS).

2. In order to expedite the processing of export permit applications, exporters are encouraged to obtain appropriate end-use assurances from importers well in advance of applying for an export permit. This ensures that applications are processed with minimal delays.

3. Under certain defined circumstances, the need for end-use assurances may be waived. Please refer to paragraph 11 (Waiver of End-use Documentation).

International Import Certificates (IIC)

4. Where an International Import Certificate (IIC) is required, the exporter must request that the importer obtain an IIC from the appropriate import authority of the importing country. The IIC defines the items and quantities of the shipment. The IIC allows the government of the importing country to ensure that the goods are not diverted en route or upon arrival.

5. The importer must send the original to the Canadian exporter, who then attaches it to the export permit application. Exporters should note that IICs usually have a limited validity period (normally 6 months) and must be submitted to the Export Controls Division within the validity period.

6. For exports to Canada, the foreign government may require a Canadian IIC before the foreign export permit/licence is issued. The Canadian importer applies for the IIC from the Export Controls Division (EPE).

End-Use Certificates (EUC)/ Import Licences (IL)

7. The Canadian exporter should request that the importer obtain an EUC or IL, whichever is applicable, from the foreign government. The foreign importer forwards this document to the Canadian exporter who attaches the original to the export permit application.

Delivery Verification Certificates (DV)

8. 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, Canadian exporters may be required to obtain DVs from the importer's government. DVs are normally issued by import or export control authorities in the country of final destination. 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-issued IIC.

9. In the case of exports to Canada, the foreign government may require a Canadian DV. The foreign exporter will request that the Canadian importer obtain a Canadian DV. Applications are available from the Export Controls Division.

End-Use Statements (EUS)

10. In lieu of an end-use certificate or other official assurances about the final use of a good, an End-use Statement (EUS) from an importer may be acceptable. The statement must be on the importer's letterhead (a photocopy is not acceptable) and must:
    i) identify the final end-user, the final location where the goods will be delivered, as well as the purpose and use of the products to be imported;
    ii) correspond to the commodity description which appears on the export permit application;
    iii) identify whether there is any potential military use intended or if the goods and technology are to be used for civilian purposes;
    iv) declare that the imported goods and technology will not be diverted or re-exported for any reason; **and**
    v) declare whether the goods and technology will be used for any purposes associated with the development or production of chemical, biological or nuclear weapons, or their delivery systems (i.e. missiles).

Waiver of End-use Documentation

11. At the discretion of the Export Controls Division, the supporting documentation requirements may be waived for applications involving the export of certain goods and technology, or to certain end-users. Exporters who consider that their particular transaction qualifies for waiver of supporting documentation should state this in the body of the export permit application. The following are common examples of discretionary waiver:
    i. Single Shipments of Less Than $10,000 (Cdn) (Except Firearms)
    ii. Exports to Government Departments or Agencies (All ECL Groups)
    Government Departments are entities operated by government-paid personnel performing governmental administrative functions: e.g., Ministry of Defence, Ministry of Health; etc. 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.

iii. Private firms purchasing on behalf of their governments
This includes firms involved in the modification or assembly of a final product whose end-user is the government. Proof of a contractual relationship should be provided.
iv. Relief Agencies for Use in Relief Projects
v. Educational Institutions (e.g. University, Academy, College, Research Institute, etc)
vi. Temporary Permits (All ECL Groups)
For an application to export goods for exhibition, demonstration or testing purposes.
vii. Maintenance/Repair Parts - Commercial Aircraft
viii. Maintenance/Repair Parts - Other Goods
ix. Export of Returned Goods from Canada

Returned goods are those:

- returned from Canada to a foreign country for repair or replacement;
- returned after being repaired in Canada; ***or***
- replacing goods previously exported from Canada which have been returned to Canada for replacement.
Note: *For vii, viii and ix proof of a previously authorised export will be required. In certain cases, GEP 1 may apply to exports in situations identified in paragraphs vii, viii and ix above.*

End-use Assurance for Firearms, Components, Ammunition and Explosives

12. Export permits for firearms, firearm components and ammunition will not be issued unless the exporter provides an import permit or other proof that the items will be legally entered into the country of destination. To meet the requirements of the *OAS Convention on Firearms, Explosives and Related Material* proof of a transit authorisation may be required if the goods are transiting a third country.

Countries Administering IIC, IL, EUC, and DV Requirements

13. Many countries maintain end-use assurance systems. While the list below identifies those countries that are known to have these systems in place, other countries not listed may also have acceptable systems.

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

**Customs Certificate in lieu of a DV*

J. What Does Customs Require and What Do I Do If My Goods Are Detained or Seized?

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

2. At the time the goods or technology are presented for export it is necessary to present a completed Canada Customs and Revenue Agency (CCRA) Export Declaration (Form B -13A) 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. Where a permit is required, it is the responsibility of the exporter to cite the Individual Export Permit number or the General Export Permit number in Box 9 of the B-13A. **If no permit is required, this must be stated on the export documentation.**

3. 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 -13A (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 quantity or value limits of the export permit (refer to Section H).

4. For more information on presentation and processing of Customs' export documents, please contact your local CCRA office.

5. Exporters believed to be in violation of the *Export and Import Permits Act* (EIPA) may have their goods detained or seized by CCRA. If seized, the exporter may be liable for severe penalties under the *Customs Act* or the EIPA. Following seizure, CCRA assumes the sole responsibility for all seized goods and their final disposition will be determined through an adjudication process. The Export Controls Division will not enter into any correspondence over goods that have been seized.

6. If the basis for the seizure is upheld, forfeiture of the goods or an ascertained forfeiture (equivalent to a fine) may occur, or a fine itself may be levied.

7. Permits are not valid for goods under seizure until such time as the goods may be released to the exporter.

   Reminder: *CCRA compares the goods and technology described on the export permit and the Customs Export Declaration form B-13A or equivalent export documentation with the contents of the shipment. Discrepancies in documentation, exports without a permit, or shipped to a consignee not listed on the permit, the use of an expired permit, among others, may result in a detention. Pending clarification, or if a violation has occurred, the goods may be seized. Such goods and technology are not exempt from controls and require a permit, either individual or general (GEP). Where goods and technology may be exported under a GEP, there is an obligation on the part of the exporter to cite the appropriate GEP number on the B-13A. Where the goods and technology are tendered for export without citing the appropriate permit number, they may be detained or seized.*

8. Exporters whose goods are being detained by Customs may contact the Export Controls Division at (613) 996-2387.

K. What Is Canada's Legislative And Policy Basis For Export Controls?

General

1. The Minister of Foreign Affairs is responsible for the administration of the *Export and Import Permits Act* (EIPA). The Export Controls Division, Export and Import Controls Bureau administers this Act on behalf of the Minister. The Export Controls Division also co-operates with other government departments and agencies which administer separate policies and procedures, and exercise separate licensing responsibilities related to the export of controlled goods and technology pursuant to other relevant legislation. Generally speaking, there are established guidelines, procedures, and policies with respect to exports of strategic and military goods and technology.

Strategic Goods and Technology

2. Groups 1, 3, 4, 6 and 7 of the *Export Control List* cover strategic as well as dual-use goods and technology. Dual-use goods and technology, materials, equipment and components, though mainly civil/commercial in nature could contribute to chemical, biological and nuclear weapons proliferation, and their missile delivery systems, as well as the development of conventional weapons. Generally, exports of strategic and dual-use civilian goods and technology are considered favourably with some exceptions. For example, an export permit application may be denied where there is a risk of diversion of the goods and technology to an unacceptable use or destination or, where secondary military uses might be foreseen. An export permit application may be denied where there is a risk of proliferation of nuclear explosive activity or unsafeguarded nuclear fuel cycle activity (Groups 3 and 4), missile systems (Group 6) or chemical/biological weapons (Group 7) to any country. The onus is on the exporter to indicate the final destination of the goods and technology.

Military Goods and Technology,

3. With respect to military goods and technology, 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.

Policy Assessments

4. After a technical assessment is completed to determine the control status of the proposed export, further consideration is given to the country of final destination and the intended use and end-user of the product. In many cases, a thorough consideration of the relevant foreign policy and security concerns is undertaken. This may include policy considerations from other branches of government through a consultation process. Where concerns exist about a proposed export, ministerial guidance will be sought. For some countries and categories of goods and technology, this may be a protracted process.

Consultations

5. The purpose of intra/interdepartmental consultations is to fully assess the risks and implications related to proposed exports. Various Canadian government departments, agencies or boards may be involved in the export control consultation process. Consultations may be carried out at the national, bilateral or multilateral levels.

L. What are Canada's Multilateral Commitments and How do They Relate to the ECL?

Wassenaar Arrangement (ECL Groups 1 and 2)

1. The Wassenaar Arrangement (WA) on Export Controls for Conventional Arms and Dual-use Goods and Technology was established in order to contribute to regional and international security and stability, by promoting transparency and greater responsibility in transfers of conventional arms and dual-use goods and technology, thus preventing destabilising accumulations. The participating states of the WA seek to ensure that transfers of these items do not contribute to the development or enhancement of military capabilities which undermine these goals, and are not diverted to support such capabilities.

2. The WA complements and reinforces, with minimal duplication, the existing control regimes for weapons of mass destruction and their delivery systems. This arrangement is also intended to enhance co-operation to prevent the acquisition of armaments and sensitive dual-use items for military end-uses, if the situation in a region or the behaviour of a state is, or becomes, a cause for serious concern to the participating states. Finally, it will not be directed against any state or group of states and will not impede bona fide civil transactions. ECL Group 1 comprises dual-purpose goods and technology that have both civilian and military application. ECL Group 2 comprises goods and technology that are specially designed or modified for military purposes.

Nuclear Non-proliferation (ECL Groups 3 and 4)

3. Canada has a long-standing nuclear non-proliferation policy that is designed, *inter alia*, to ensure that Canada's nuclear exports are not used for any nuclear explosive purpose. Canada has bilateral co-operation agreements in which there are reciprocal commitments with its nuclear trading partners. 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 (NNWS) 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 understanding with respect to the implementation of this commitment.

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

5. Group 3 includes goods and technology that are nuclear-specific. Group 4 includes goods and technology that are nuclear related, dual-use, goods and technology; that is, items that can be used for nuclear as well as non-nuclear applications and that could be used in a nuclear explosive activity or a non-safeguarded nuclear fuel cycle activity.

Miscellaneous Goods and Technology (ECL Group 5)

6. Canada is a participant in a number of bilateral and multilateral arrangements designed to control the export from Canada of various other strategic and non-strategic items. Included in Group 5 are forest products, medical products, agricultural and food products, U.S. origin goods (refer to Section E), anti-personnel land mines, blinding laser weapons, nuclear fusion reactors, certain goods for which controls were deemed necessary under a bilateral arrangement with the U.S., as well as "Goods for Certain Uses".

7. Item 5504 covers "strategic goods and technology" which include certain global navigation satellite systems, propulsion and space-related equipment, payloads, ground control stations, chemiluminescent compounds, radiation-hardened microelectronic circuits, nuclear weapons test design and equipment, as well as related software and technology (refer to Section E).

8. Group 5 further includes the new Item 5505 (*Goods for Certain Uses*). This item covers non-listed, commercial/civilian goods and technology, which could make a serious or major contribution to the proliferation of chemical, biological or nuclear weapons, or their missile delivery systems, if those goods or technology were to fall into the hands of questionable end-users or destined to dubious end-uses.

Missile Technology Control Regime (ECL Group 6)

9. The MTCR was established in 1987 to address concerns about the proliferation of systems capable of delivering weapons of mass destruction, namely chemical, biological or nuclear weapons. Group 6 includes goods and technology agreed upon by the MTCR that are used or could be used in the proliferation of systems capable of delivering chemical, biological or nuclear weapons.

Australia Group (ECL Group 7)

10. In 1985, Canada, together with a number of other countries, agreed that the proliferation of chemical and biological weapons required immediate attention and formed the Australia Group (AG). The Australia Group controls chemical substances and biological agents and related equipment and technology that could be used in the production of chemical and biological weapons. Chemical weapon precursors and biological agents and related dual-use equipment are identified in Group 7 of this Guide.

Chemical Weapons Convention/Biological and Toxin Weapons Convention (ECL Group 7)

11. Also contained in ECL Group 7 (and to a lesser degree in Group 2) are chemicals and precursors controlled under the *Chemical Weapons Convention* (CWC). Many of the CWC chemicals and precursors are also controlled by the Australia Group. As well, many of the AG toxins and agents are also controlled under the *Biological and Toxin Weapons Convention* (BTWC).

M. How do I Use the ECL and Find Information in the Guide?

1. This Guide contains the *Export Control List*, a lengthy and very technical list of goods and technology that require permits from DFAIT if they are exported. Understanding how to read the ECL and how to find information in it is vital. This section will help explain how the ECL is organised, and how to find specific information in it.

Reading the ECL

2. The ECL is divided into eight different chapters, known as **Groups**. These Groups each consist of items that in many ways appear similar to each other. The following is a list of all of the Groups, and the items that they control:

   Group 1: Dual-use List*
   Group 2: Munitions List
   Group 3: Nuclear Non-Proliferation List
   Group 4: Nuclear-Related Dual-use List*
   Group 5: Miscellaneous Goods and Technology
   Group 6: Missile Technology Control Regime List
   Group 7: Chemical and Biological Weapons Non- Proliferation List
   Group 8: Chemicals for the Production of Illicit Drugs.
   * “Dual-Use” items are industrial products with a civilian/military or nuclear/non-nuclear use.

3. The text of each Group reflects the international agreement(s) that Canada has entered into concerning the items controlled in that Group. For example, the text of Group 7, which deals with chemical and biological weapons, is very similar to the texts of the Australia Group arrangement on chemical and biological weapons and the *Chemical Weapons Convention* Treaty.

4. Each portion of distinct information in the ECL is known as an **Item**. Items are the bits of information that make up the ECL, and are collected into the Groups. Items are numbered to make it easier to find the information.

5. Numbering of Items reflects the Group that contains that Item. For example, in Group 2 (Munitions), all of the Items begin with the number 2. For example, Item 2004 includes bombs, torpedoes and rockets. Item 2005 includes fire control systems, such as bomb sights. Group 4 Items (Nuclear-Related Dual-Use) begin with the number 4, Group 6 Items (Missile Technology Control Regime) begin with the number 6, and so on. This is important to remember, and makes it easier to find a listed good or technology.

6. **Sub-Items** are also given unique numbers. Numbers for sub-items are based upon the main Item number to which the sub-item refers: for example, Item 2004.a. is a sub-item of Item 2004. When there are many sub-items, the numbering can become complicated. Consider, for example, Item 1061 has dozens of sub-items, of which one is 1061.5.c.2.b.1., which addresses Q-switched lasers.

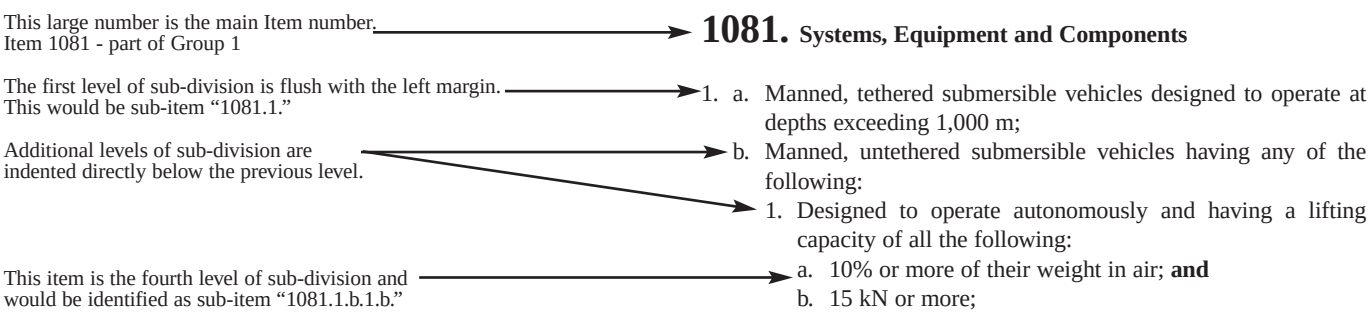
7. As evidenced by the example above, the number of sub-items alternates between number and letter. Thus, in 1061.5.c.2.b.1.:
   1061. is the main Item
      5. is the first level of sub-item
         c. is the second level of sub-item
            2. is the third level
               ...etc.

8. In addition to numbering, sub-items are identified by indentations in to the text.

9. Many of the terms in the ECL are in quotations. For example, “aircraft” appears several times. These quotes signify that the word or phrase contained in the quotes has a specific **definition** in the Guide. The definitions for terms are found at the end of each Group, and apply to that specific Group. The definitions originate from the various international agreements and arrangements to which Canada subscribes.

10. Below is an example that illustrates the text of the ECL. It may help demonstrate how the numbering system is structured, and how Items/sub-items relate to one another.

An Example of ECL Text



11. It is common for readers to know specifically what products they deal with, and if those goods and technology are controlled. There are two main ways to try to locate specific goods and technology:
   i) Use the **Index** to specifically find the Item; **or**
   ii) Search through Groups that contain like products to find any Items that might apply to your goods and technology.

12. The first step is obvious. At the back of this Guide is a detailed, but not exhaustive, index to items found in the ECL. By using this index, readers can quickly find all of the important references the ECL may have concerning a specific good. Exporters are cautioned that the index is not all-inclusive and that generic names or other terms may be used in place of common or trade terminology.

13. If specific goods and technology are not mentioned, exporters are advised to review the pertinent sections of the ECL to find out if controls nonetheless apply. This is because some Items apply to a large number of goods and technology but do not list them by name; hence the goods and technology do not appear in the index. Exporters are encouraged to contact the responsible government department or agency if there is any doubt about the applicability of a particular product or commodity. Item 5400, in Group 5 of the ECL, is a good example of this. No specific goods and technology are mentioned in Item 5400, but all U.S. origin goods as defined therein require an export permit, regardless of destination or the nature of the good.

Goods and Technology Identified Under More Than One Group /Item of this Guide

14. Each Group of this Guide must be considered independently, but goods or technology 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.

N. What Goods are Subject to Import Controls?

1. Canada has a range of goods over which it imposes import controls. These goods are listed in the *Import Control List* (ICL) of the *Export and Import Permits Act*. Military goods and firearms are controlled by paragraphs 70-73 and 91, and *Chemical Weapons Convention* items are controlled by paragraph 74 of the ICL.

2. Applications for import permits for these items must be submitted to the Export Controls Division (EPE). They may be requested by telephone or mail at the number and address shown in the inside front cover of this Guide.

3. Current policy allows for the waiver of an import permit for goods set out in Para 70, (1), a) and b), and their parts, when destined to sporting or recreational use (refer to Notice to Importers No. 352). At time of publication, it is anticipated that the responsibility for issuing import permits for firearms listed in paragraph 70 (1) will be assumed by the Canadian Firearms Centre (1-800-731-4000).

International Import Certificates

4. A Canadian-issued International Import Certificate (IIC) may be required by an exporting country prior to that country authorising an export permit/licence. An IIC does not replace an import permit where a permit is required.

O. What are the Current Notices to Exporters?

The Export Controls Division issues various Notices to Exporters to assist the exporting community in understanding current policies and procedures. While the most current Notices can be found on the departmental WEB Site at http:\\www.dfait-maeci.gc.ca/~eicb/export/milit_tech-e.htm, at time of publication of this Guide, the following Notices to Exporters were in effect.

No.	Subject
26.	Exports of Red Cedar Suitable for Use in the Manufacture of Shakes and Shingles
52.	Export of Unprocessed Roe Herring
72.	Nuclear and Nuclear-related Dual-use
74.	Chemical and Biological Weapons
79.	Croatia
81.	Peanut Butter
82.	Sugar-Containing Products
83.	Changes to the Export and Import Permits and Certificates Fees
86.	Transfer of Missile Equipment and Technology
88.	Textiles and Clothing: Administration under NAFTA
89.	Yugoslavia

No.	Subject *(con't)*
90.	Softwood Lumber
92.	Item 5104: Softwood Lumber Products
102.	Exports of logs from British Columbia
105.	Export controls over Chemicals Covered by the Chemical Weapons Convention (CWC)
109.	New Financial Administration Rules on Export Permits/Certificates of Eligibility
113.	Export Controls on Cryptographic Goods
567.	Notice to Importers: Import controls over chemicals covered by the Chemical Weapons Convention
TBA	Export Controls and the Controlled Goods Registration Programme
TBA	Goods for Certain Uses (Catch-all)

P. What Acronyms are Used in this Guide?

ACL	*Area Control List*
AFCCL	*Automatic Firearms Country Control List*
AG	Australia Group
B-13A	Customs Export Declaration Form
CA	*Customs Act*
CCRA	Canada Customs and Revenue Agency
CWC	*Chemical Weapons Convention*
CGR	*Controlled Goods Regulations*
CGRP	Controlled Goods Registration Programme
CNSC	Canadian Nuclear Safety Commission
DFAIT	Department of Foreign Affairs and International Trade
DIAND	Department of Indian Affairs and Northern Development
DPA	*Defence Production Act*
DV	Delivery Verification Certificate
ECL	*Export Control List*
EIPA	*Export and Import Permits Act*
EPE	Export Controls Division
EPR	*Export Permits Regulations*
EUC	End-use Certificate
EUS	End-Use Statement
EXT-1020	International Import Certificate
EXT-1042	Application for Permit to Export Goods
EXT-1046	Delivery Verification Certificate
EXT-1718	Application to Advertise Logs on the B.C. Federal Bi-Weekly List
EXT-1719	Information on Logs in Support of Federal Application EXT-1042
GEP	General Export Permit
IAEA	International Atomic Energy Agency
IEP	Individual Export Permit
IIC	International Import Certificate
IL	Import Licence
IPR	*Import Permits Regulations*
ITAR	*International Traffic in Arms Regulations*
MTCR	Missile Technology Control Regime
NAFTA	*North American Free Trade Agreement*
NBCW	Nuclear, Biological and Chemical Weapons
NNWS	Non-Nuclear Weapons State
NPT	*Nuclear Non-proliferation Treaty*
NSG	Nuclear Suppliers' Group
OAS	Organisation of American States
OPC	Open Policy Countries
OPCW	Organisation for the Prohibition of Chemical Weapons
RCMP	Royal Canadian Mounted Police
UN	United Nations
WA	Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technology
WMD	Weapons of Mass Destruction

Group 1 - Dual-Use List

Note:
Terms in "double quotation marks" are defined terms. Refer to definitions at the end of Group 2.

General "Technology" Note
The export of "technology" which is "required" for the "development", "production" or "use" of products controlled in the Dual-Use List is controlled according to the provisions in each Category. This "technology" remains under control even when applicable to any uncontrolled 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 not controlled or whose export has been authorised.

N.B.:
This does not release such "technology" controlled in entries 1015.2.e. & 1015.2.f. and 1085.2.a. & 1085.2.b.

Controls do not apply to "technology" "in the public domain", to "basic scientific research" or to the minimum necessary information for patent applications.

General "Software" Note
The Dual-Use List does not control "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;*
      3. *Electronic Transactions;* ***or***
      4. *Telephone call transactions;* ***and***
   b. *Designed for installation by the user without further substantial support by the supplier;* ***or***

   N.B.:
   Entry 1 of the General Software Note does not release "software" controlled by Category 1150.

2. *"In the public domain".*

Category 1010: Advanced Materials

1011. Systems, Equipment 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% by weight of any of the materials controlled by 1013.9.b. or 1013.9.c.;
   b. Piezoelectric polymers and copolymers made from vinylidene fluoride materials controlled by 1013.9.a.:
      1. In sheet or film form; **and**
      2. With a thickness exceeding 200 μm;
   c. Seals, gaskets, valve seats, bladders or diaphragms made from fluoroelastomers containing at least one vinylether group as a constitutional unit, specially designed for "aircraft", aerospace or missile use.
2. "Composite" structures or laminates, having any of the following:
   a. An organic "matrix" and made from materials controlled by 1013.10.c., 1013.10.d. or 1013.10.e.; **or**
   b. A metal or carbon "matrix" and made from:
      1. Carbon "fibrous or filamentary materials" with:
         a) A specific modulus exceeding 10.15 x 10^6 m; **and**
         b. A specific tensile strength exceeding 17.7 x 10^4 m; **or**
      2. Materials controlled by 1013.10.c.

Note 1:
Item 1011.2. does not control finished or semi-finished items specially designed for purely civilian applications as follows:

1. *sporting goods;*
2. *automotive industry;*
3. *machine tool industry;*
4. *medical applications.*

Note 2:
1011.2. does not control 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 m^2.

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 ± 2) K ((23 ± 2)°C) and a relative humidity of (50 ± 5)%.*
2. *Specific tensile strength: ultimate tensile strength in pascals, equivalent to N/m2 divided by specific weight in N/m3, measured at a temperature of (296 ± 2) K((23 ± 2)°C) and a relative humidity of (50 ± 5)%.*

3. Manufactures of non-fluorinated polymeric substances controlled by 1013.8.a.3., 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.

   Note:
   1011.3. does not control manufactures when coated or laminated with copper and designed for the production of electronic printed circuit boards.

4. Protective and detection equipment and components not specially designed for military use, as follows:
   a. Gas masks, filter canisters and decontamination equipment therefore designed or modified for defence against biological agents or radioactive materials "adapted for use in war" or chemical warfare (CW) agents and specially designed components therefore;
   b. Protective suits, gloves and shoes specially designed or modified for defence against biological agents or radioactive materials "adapted for use in war" or chemical warfare (CW) agents;
   c. Nuclear, biological and chemical detection systems (NBC) specially designed or modified for detection or identification of biological agents or radioactive materials "adapted for use in war" or chemical warfare (CW) agents and specially designed components therefore.

   Note:
   Item 1011.4. does not control :
   a. Personal radiation monitoring dosimeters;
   b. Equipment limited by design or function to protect against hazards specific to civil industries, such as mining, quarrying, agriculture, pharmaceuticals, medical, veterinary, environmental, waste management, or to the food industry.

   N.B.:
   Also see Item 2007. on Munitions List.

5. Body armour, and specially designed components therefore, not manufactured to military standards or specifications, nor to their equivalents in performance.

   Note 1:
   Item 1011.5. does not control individual suits of body armour and accessories therefore, when accompanying their users for his/her own personal protection.

   Note 2:
   Item 1011.5. does not control body armour designed to provide frontal

1011.5. notes con't.

protection only from both fragment and blast from non-military explosive devices.

N.B.:

Also see Item 2013. on Munitions List.

1012. Test, Inspection and Production Equipment

1. Equipment for the production of fibres, prepregs, preforms or "composites" controlled by 1011.2. or 1013.10., as follows, and specially designed components and accessories therefore:
   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;

      Note:

      Item 1012.1.c. does not control 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 aluminum oxide);
      4. Equipment for converting aluminum containing precursor fibres into alumina fibres by heat treatment;
   e. Equipment for producing prepregs controlled 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. Equipment for producing metal alloys, metal alloy powder or alloyed materials, specially designed to avoid contamination and specially designed for use in one of the processes in 1013.2.c.2.
3. Tools, dies, moulds or fixtures, for "superplastic forming" or "diffusion bonding" titanium or aluminum 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

Technical Note:

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, brickets, 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, atomizing, 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 control 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.

1. Materials specially designed for use as absorbers of electromagnetic waves, or intrinsically conductive polymers, as follows:
   a. Materials for absorbing frequencies exceeding 2 x 10^8 Hz but less than 3 x 10^{12} Hz;

      Note 1:

      Item 1013.1.a. does not control:

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

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

      c. Planar absorbers, having all of the following characteristics:

      1. Made from any of the following:

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

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

      Technical Note:

      Absorption test samples for 1013.1.a. Note1.c.1. 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.

      2. Tensile strength less than 7 x 10^6 N/m^2; ***and***

      3. Compressive strength less than 14 x 10^6 N/m^2;

      d. Planar absorbers made of sintered ferrite, having:

      1. A specific gravity exceeding 4.4; and

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

      Note 2.:

      Nothing in this note 1 releases magnetic materials to provide absorption when contained in paint.

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

1013.1. con't.

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 and alloyed materials, as follows:
   Note:
   1013.2. does not control metal alloys, metal alloy powder and alloyed materials for coating substrates.

   a. Aluminides, as follows:
      1. Nickel aluminides containing a minimum of 15 weight percent aluminum, a maximum of 38 weight percent aluminum and at least one additional alloying element;
      2. Titanium aluminides containing 10 weight percent or more aluminum and at least one additional alloying element;
   b. Metal alloys, as follows, made from material controlled by 1013.2.b.:
      1. Nickel alloys with:
         a. A stress-rupture life of 10,000 hours or longer at 923 K (650°C) at a stress of 676 MPa; **or**
         b. A low cycle fatigue life of 10,000 cycles or more at 823 K (550°C) at a maximum stress of 1,095 MPa;
      2. Niobium alloys with:
         a. A stress-rupture life of 10,000 hours or longer at 1,073 K (800°C) at a stress of 400 MPa; or
         b. A low cycle fatigue life of 10,000 cycles or more at 973 K (700°C) at a maximum stress of 700 MPa;
3. Titanium alloys with:
   a. A stress-rupture life of 10,000 hours or longer at 723 K (450°C) at a stress of 200 MPa; or
   b. A low cycle fatigue life of 10,000 cycles or more at 723 K (450°C) at a maximum stress of 400 MPa;
4. Aluminum alloys with a tensile strength of:
   a. 240 MPa or more at 473 K (200°C); **or**
   b. 415 MPa or more at 298 K (25°C);
5. Magnesium alloys with:
   a. a tensile strength of 345 MPa or more; **and**
   b. a corrosion rate of less than 1 mm/year in 3% sodium chloride aqueous solution measured in accordance with ASTM standard G-31 or national equivalents;

      Technical Notes:
      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_t) equal to 1) The average stress is defined as maximum stress minus minimum stress divided by maximum stress.*

   c. Metal alloy powder or particulate material having all of the following characteristics:
      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 μm 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. Aluminum 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";
      3. Capable of forming material controlled by 1031.2.a. or 1031.2.b.2.d.
   d. Alloyed materials, having all of the following characteristics:
      1. Made from any of the composition systems specified in 1031.2.c.1.;
      2. In the form of uncomminuted flakes, ribbons or thin rods; **and**
      3. Produced in a controlled environment by any of the following:
         a. "Splat quenching";
         b. "Melt spinning" **or;**
         c. "Melt extraction";
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, having any of the following characteristics:
      1. A saturation magnetostriction of more than 5×10^{-4}; **or**
      2. A magnetomechanical coupling factor (k) of more than 0.8; **or**
   c. Amorphous or nanocrystalline alloy strips having all of the following characteristics:
      1. A composition having a minimum of 75 weight percent of iron, cobalt or nickel;
      2. A saturation magnetic induction (B_S) of 1.6 T or more; **and**
      3. Any of the following:
         a) A strip thickness of 0.02 mm or less; or
         b. An electrical resistivity of 2×10^{-4} ohm cm or more.

      Technical Note:
      'Nanocrystalline' materials in 1013.3.c. are those materials having a crystal grain size of 50 nm or less, as determined by X-ray diffraction.

4. Uranium titanium alloys or tungsten alloys with a "matrix" based on iron, nickel or copper, having all of the following:

1013.4. con't.

a. A density exceeding 17.5 g/cm^3;
b. An elastic limit exceeding 880 MPa;
c. An ultimate tensile strength exceeding 1270 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. Having a cross-section area less than 0.28 x 10^{-4} mm^2 (6 µm in diameter for circular filaments);
   b. "Superconductive" "composite" conductors consisting of one or more "superconductive" filaments other than niobium-titanium, having all of the following:
      1. 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 x 10^{-4} mm^2; **and**
      3. Remaining 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 silahydrocarbon oils, having all of the following:
         Technical 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, having all of the following:
         Technical 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 mm^2/s (5,000 centistokes) measured at 298 K (25°C);
   c. Damping or flotation fluids with a purity exceeding 99.8%, containing less than 25 particles of 200 µm or larger in size per 100 ml and made from at least 85% of any of the following compounds or materials:
      1. Dibromotetrafluoroethane;
      2. Polychlorotrifluoroethylene (oily and waxy modifications only); **or**
      3. Polybromotrifluoroethylene;
   d. Fluorocarbon electronic cooling fluids having all of the following characteristics:
      1. Containing 85% by weight or more of any of the following, or mixtures thereof:
         a. Monomeric forms of perfluoropolyalkylether-triazines or perfluoroaliphatic-ethers;
         b. Perfluoroalkylamines;
         c. Perfluorocycloalkanes; **or**
         d. Perfluoroalkanes;
      2. Density at 298 K (25°C) of 1.5 g/ml or more;
      3. In a liquid state at 273 K (0°C); **and**
      4. Containing 60% or more by weight of fluorine.

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 ± 6 K (371 ± 6°C) for six hours;
The specimen will be considered thermally stable if, on completion of the above procedure, all of the following conditions are met:
1. The loss in weight of each ball is less than 10 mg/mm^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 µm and no more than 10% of the particles larger than 10 µm;
   b. Non-"composite" ceramic materials in crude or semi-fabricated form, composed of borides of titanium with a density of 98% or more of the theoretical density;
      Note:
      Item 1013.7.b. does not control abrasives.
   c. Ceramic-ceramic "composite" materials with a glass or oxide-"matrix" and reinforced with fibres having all of the following:
      Made from any of the following materials:
      1. Si-N;
      2. Si-C;
      3. Si-Al-O-N; **or**
      4. Si-O-N;

      Having a specific tensile strength exceeding 12.7 x 10^3 m;
   d. Ceramic-ceramic "composite" materials, with or without a continuous metallic phase, incorporating particles, whiskers or fibres, where carbides or nitrides of silicon, zirconium or boron form the "matrix";

1013.7. con't.

e. Precursor materials (i.e., special purpose polymeric or metallo-organic materials) for producing any phase or phases of the materials controlled 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);

f. Ceramic-ceramic "composite" materials with an oxide or glass "matrix" reinforced with continuous fibres from any of the following systems:
   1. Al2O3; **or**
   2. Si-C-N.

Note:
1013.7.f. does not control "composites" containing fibres from these systems with a fibre tensile strength of less than 700 MPa at 1,273 K (1,000° C) or fibre tensile creep resistance of more than 1% creep strain at 100 MPa load and 1,273 K (1,000° C) for 100 hours.

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 513 K (240°C) determined using the dry method described in ASTM D 3418.

   Note:
   1013.8.a. does not control 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^2 and composed of:
      1. Any 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.

Technical Note:
The glass transition temperature (Tg) for 1013.8. materials is determined using the method described in ASTM D 3418 using the dry method.

9. Unprocessed fluorinated compounds, as follows:
   a. Copolymers of vinylidene fluoride having 75% or more beta crystalline structure without stretching;
   b. Fluorinated polyimides containing 10% 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" having all of the following:
      1. A specific modulus exceeding 12.7 x 10^6 m; **and**
      2. A specific tensile strength exceeding 23.5 x 10^4 m;

   Note:
   1013.10.a. does not control polyethylene.

   b. Carbon "fibrous or filamentary materials", having all of the following:
      1. A specific modulus exceeding 12.7 x 10^6 m; **and**
      2. A specific tensile strength exceeding 23.5 x 10^4 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 control 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", having all of the following:
      1. A specific modulus exceeding 2.54 x 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 control :
   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 x 106 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 controlled by 1013.8.a; **or**
         b. Materials controlled by 1013.8.b. to 1013.8.f.; **or**
      2. Composed of materials controlled by 1013.10.d.1.a. or 1013.10.d.1.b. and "commingled" with other fibres controlled by 1013.10.a., 1013.10.b. or 1013.10.c.;

   e. Resin-impregnated or pitch-impregnated fibres (prepregs), metal or carbon-coated fibres (preforms) or "carbon fibre preforms", as follows:
      1. Made from "fibrous or filamentary materials" controlled by 1013.10.a., 1013.10.b. or 1013.10.c.;
      2. Made from organic or carbon "fibrous or filamentary materials":
         a. With a specific tensile strength exceeding 17.7 x 10^4 m;
         b. With a specific modulus exceeding 10.15 x 10^6 m;
         c. Not controlled by 1013.10.a. or 1013.10.b.; **and**
         d. When impregnated with materials controlled by 1013.8. or 1013.9.b., having a glass transistion temperature (T_g) exceeding 383 K (110°C) or with phenolic or epoxy resins, having a glass transition temperature (T_g) exceeding 418 K (145°C).

   Note:
   1013.10.e. does not control:

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1. *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;*
2. *Prepregs when impregnated with phenolic or epoxy resins having a glass transition temperature (Tg) less than 433 K (160°C) and a cure temperature lower than the glass transition temperature.*

Technical Note:

The glass transition temperature (Tg) for 1013.10.e. materials is determined using the method described in ASTM D 3418 using the dry method. The glass transition temperature for phenolic and epoxy resins is determined using the method described in ASTM D 4065 at a frequency of 1 Hz and a heating rate of 2 K (2°C) per minute using the dry method.

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 ± 2) K ((23 ± 2)°C) and a relative humidity of (50 ± 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 ± 2) K((23 ± 2)°C) and a relative humidity of (50 ± 5)%.*

11. Metals and compounds, as follows:
    a. Metals in particle sizes of less than 60 μm whether spherical, atomised, spheroidal, flaked or ground, manufactured from material consisting of 99% or more of zirconium, magnesium and alloys of these;

    Technical Note:

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

    Note:

    The metals or alloys listed in 1013.11.b. are controlled whether or not the metals or alloys are encapsulated in aluminum, magnesium, zirconium or beryllium.

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

    Note:

    The metals or alloys listed in 1013.11.b. are controlled whether or not the metals or alloys are encapsulated in aluminum, magnesium, zirconium or beryllium.

    c. Guanidine nitrate.
    d. Nitroguanidine (NQ) (CAS 556-88-7)
12. Materials as follows:

    Technical Note:

    These materials are typically used for nuclear heat sources.

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

    Note:

    1013.12.a. does not control:

    1. *Shipments with a plutonium content of one 1 g or less;*
    2. *Shipments of 3 "effective grammes" or less when contained in a sensing component in instruments.*

    b. "Previously separated" neptunium-237 in any form.

    Note:

    1013.12.b. does not control shipments with a neptunium-237 content of 1 g or less.

1014. Software

1. "Software" specially designed or modified for the "development", "production" or "use" of equipment controlled 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 controlled by 1011.1.b., 1011.1.c., 1011.2. to 1011.5.,1012. or 1013.
2. Other "technology", as follows:
    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 vinylether 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 aluminum;
                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. Being any of the following:
                1. Zirconia with an average particle size equal to or less than 1 μm and no more than 10% of the particles larger than 5 μm.
                2. Other base materials with an average particle size equal to or less than 5 μm and no more than 10% of the particles larger than 10 μm; or
                3. Having all of the following:
                    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 μm; **and**
                    c. Continuous or chopped fibres less than 10 μm in diameter;
    c. 2. Non-"composite" ceramic materials composed of the materials described in 1015.2.c.1.;

    Note:

    1015.2.c.2. does not control technology for the design or production of abrasives.

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

    Note:

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

Category 1020: Materials Processing

1021. Systems, Equipment and Components

N.B.:
For quiet running bearings, see Item 2009. on the Munitions List.

1. Anti-friction bearings and bearing systems, as follows, and components therefore:
   Note:
   1021.1. does not control balls with tolerances specified by the manufacturer in accordance with ISO 3290 as grade 5 or worse.

   a. Ball bearings and solid roller bearings having all tolerances specified by the manufacturer in accordance with ISO 492 Tolerance Class 4 (or ANSI/ABMA Std 20 Tolerance Class ABEC-7 or RBEC-7, or other national equivalents), or better, and having both rings and rolling elements (ISO 5593) made from monel or beryllium;
      Note:
      1021.1.a. does not control tapered roller bearings.

   b. Other ball bearings and solid roller bearings having all tolerances specified by the manufacturer in accordance with ISO 492 Tolerance Class 2 (or ANSI/ABMA Std 20 Tolerance Class ABEC-9 or RBEC-9, or other national equivalents), or better;
      Note:
      1021.1.b. does not control tapered roller bearings.

   c. Active magnetic bearing systems using any of the following:
      1. Materials with flux densities of 2.0 T or greater and yield strengths greater than 414 MPa;
      2. All-electromagnetic 3D homopolar bias designs for actuators; **or**
      3. High temperature (450 K (177°C) and above) position sensors.

1022. Test, Inspection and Production Equipment

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. Rotary axes need not rotate over 360°. A rotary axis can be driven by a linear device (e.g., a screw or a rack-and-pinion).*
2. *For the purposes of 1022., the number of axes which can be co-ordinated simultaneously for "contouring control" is the number of axes which affect relative movement between any one workpiece and a tool, cutting head or grinding wheel which is cutting or removing material from the workpiece. This does not include any additional axes which affect other relative movement within the machine. Such axes include:*
   a. *Wheel-dressing systems in grinding machines;*
   b. *Parallel rotary axes designed for mounting of separate workpieces;*
   c. *Co-linear rotary axes designed for manipulating the same workpiece by holding it in a chuck from different ends.*
3. *Axis nomenclature shall be in accordance with International Standard ISO 841, 'Numerical Control Machines - Axis and Motion Nomenclature'.*
4. *For the purposes of this Category a "tilting spindle" is counted as a rotary axis.*
5. *Stated positioning accuracy levels derived from measurements made according to ISO 230/2 (1997) or national equivalents may be used for each machine tool model instead of individual machine tests. Stated positioning accuracy means the accuracy value provided to national licensing authorities as representative of the accuracy of a machine model.*

   Determination of Stated Values:
   a. *Select five machines of a model to be evaluated;*
   b. *Measure the linear axis accuracies according to ISO 230/2 (1997);*
   c. *Determine the A-values for each axis of each machine. The method of calculating the A-value is described in the ISO standard;*
   d. *Determine the mean value of the A-value of each axis. This mean value Â becomes the stated value of each axis for the model (Âx, Ây...);*
   e. *Since the Category 1020 list refers to each linear axis there will be as many stated values as there are linear axes;*
   f. *If any axis of a machine model not controlled by 1022.1.a. to c. has a stated accuracy Â of 5 microns for grinding machines and 6.5 microns for milling and turning machines or better, the builder should be required to reaffirm the accuracy level once every eighteen months.*

1. Machine tools, as follows, and any combination thereof, for removing (or cutting) metals, ceramics or "composites", which, according to the manufacturer's technical specification, can be equipped with electronic devices for "numerical control":
   Note 1
   1022.1. does not control special purpose machine tools limited to the manufacture of gears. For such machines, see Item 1022.3.
   Note 2
   1022.1. does not control special purpose machine tools limited to the manufacture of any of the following parts:
   a. *Crank shafts or cam shafts;*
   b. *Tools or cutters;*
   c. *Extruder worms;*
   d. *Engraved or facetted jewelry parts;*

   a. Machine tools for turning, having all of the following characteristics:
      1. Positioning accuracy with "all compensations available" equal to or less (better) than 4.5 µm according to ISO 230/2 (1997) or national equivalents along any linear axis; **and**
      2. Two or more axes which can be coordinated simultaneously for "contouring control";
      Note:
      1022.1.a. does not control turning machines specially designed for the production of contact lenses.

   b. Machine tools for milling, having any of the following characteristics :
      Having all of the following:
      1. a. Positioning accuracy with "all compensations available" equal to or less (better) than 4.5 µm according to ISO 230/2 (1997) or national equivalents along any linear axis; **and**
         b. Three linear axes plus one rotary axis which can be coordinated simultaneously for "contouring control";
      2. Five or more axis which can be coordinated simultaneously for "contouring control"; **or**
      3. A positioning accuracy for jig boring machines with "all compensations available", equal to or less (better) than 3.0 µm according to ISO 230/2 (1997) or national equivalents along any linear axis;
      4. Fly cutting machines, having all of the following characteristics:
         a. Spindle "run-out" and "camming" less (better) than 0.0004 mm TIR; **and**
         b. Angular deviation of slide movement (yaw, pitch and roll) less (better) than 2 seconds of arc, TIR, over 300 mm of travel.

   c. Machine tools for grinding, having any of the following characteristics:
      1. Having all of the following:

1022.1.c.1. con't

a. Positioning accuracy with "all compensations available" equal to or less (better) than 3.0 μm according to ISO 230/2 (1997) or national equivalents along any linear axis; **and**

b. Three or more axes which can be coordinated simultaneously for "contouring control"; **or**

2. Five or more axes which can be coordinated simultaneously for "contouring control";

Notes:

1022.1.c. does not control grinding machines, as follows:

1. *Cylindrical external, internal, and external-internal grinding machines having all the following characteristics:*
   a. *Limited to cylindrical grinding; **and***
   b. *Limited to a maximum workpiece capacity of 150 mm outside diameter or length;*
2. *Machines designed specifically as jig grinders having any of the following characteristics:*
   a. *The c-axis is used to maintain the grinding wheel normal to the work surface; **or***
   b. *The a-axis is configured to grind barrel cams.*
3. *Surface grinders.*

d. Electrical discharge machines (EDM) of the non-wire type which have two or more rotary axes which can be coordinated simultaneously for "contouring control";

e. Machine tools for removing metals, ceramics or "composites" having all of the following characteristics:

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

f. Deep-hole-drilling machines and turning machines modified for deep-hole-drilling having a maximum depth-of-bore capability exceeding 5,000 mm and specially designed components therefore.

2. Deleted.

3. "Numerically controlled" or manual machine tools, and specially designed components, controls and accessories therefore, specially designed for the shaving, finishing, grinding or honing of hardened (R_C = 40 or more) 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", having all of the following, and specially designed components and accessories therefore:
   a. A controlled thermal environment within the closed cavity and a chamber cavity with an inside diameter of 406 mm or more; **and**
   b. Any of the following:
      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.

   N.B.:

   For specially designed dies, moulds and tooling see Items 1012.3., 1092.9. and 2018.

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.f., and specially designed automated handling, positioning, manipulation and control components therefore:
   a. "Stored programme controlled" chemical vapour deposition (CVD) production equipment having all of the following:
      1. Process modified for one of the following:
         a. Pulsating CVD;
         b. Controlled nucleation thermal deposition (CNTD); **or**
         c. Plasma enhanced or plasma assisted CVD; **and**
      2. Any 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 power systems rated for over 80 kW, having any of the following:
      1. A liquid pool level "laser" control system which regulates precisely the ingots feed rate; **or**
      2. A computer controlled rate monitor operating on the principle of photo-luminescence of the ionised atoms in the evaporant stream to control the deposition rate of a coating containing two or more elements;
   d. "Stored programme controlled" plasma spraying production equipment having any of the following characteristics:
      1. Operating at 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^2 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 any of the following:
      1. Coating thickness on the substrate and rate control; or
      2. Optical characteristics.

   Note:

   1022.5.a., 1022.5.b., 1022.5.e., 1022.5.f. and 1022.5.g. do not control chemical vapour deposition, cathodic arc, sputter deposition, ion plating or ion implantation equipment specially designed for cutting or machining tools.

6. Dimensional inspection or measuring systems and equipment, as follows:

1022.6. con't

a. Computer controlled, "numerically controlled" or "stored programme controlled" dimensional inspection machines, having a three dimensional length (volumetric) "measurement uncertainty" equal to or less (better) than (1.7 + L/1,000) µm L is the measured length in mm) tested according to ISO 10360-2;

b. Linear and angular displacement measuring instruments, as follows:

1. Linear displacement measuring instruments having any of the following:

Technical Note

For the purpose of 1022.6.b.1., 'linear displacement' means the change of distance between the measuring probe and the measured object.

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 having all 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 all of the following:

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, all of the following:
   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);

Note:

1022.6.b.1. does not control 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 displacement measuring instruments having an "angular position deviation" equal to or less (better) than 0.00025°;

Note:

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

c. Equipment for measuring surface irregularities, by measuring optical scatter as a function of angle, with a sensitivity of 0.5 nm or less (better).

Note 1:

Machine tools which can be used as measuring machines are controlled if they meet or exceed the criteria specified for the machine tool function or the measuring machine function.

Note 2:

A machine described in 1022.6. is controlled if it exceeds the control threshold anywhere within its operating range.

7. "Robots", having any of the following characteristics, and specially designed controllers and "end-effectors" therefore:

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;

Technical Note:

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

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

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

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

8. Assemblies or units, specially designed for machine tools, or dimensional inspection or measuring systems and equipement, as follows:

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

N.B.

For "laser" systems see also Note to Item 1022.6.b.1.

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

N.B.

For "laser" systems see also Note to Item 1022.6.b.1.

c. "Compound rotary tables" and "tilting spindles", capable of upgrading, according to the manufacturer's specifications, machine tools to or above the levels specified in 1022.

9. Spin-forming machines and flow-forming machines, which, according to the manufacturer's technical specification, can be equipped with "numerical control" units or a computer control and having all of the following:

a. Two or more controlled axes of which at least two can be coordinated simultaneously for "contouring control"; **and**

b. A roller force more than 60 kN.

Technical Note:

Machines combining the function of spin-forming and flow-forming are for the purpose of 1022.9. regarded as flow-forming machines.

1023. Materials

None.

1024. Software

1. "Software", other than that controlled by 1024.2., specially designed or modified for the "development", "production" or "use" of equipment controlled by 1021. or 1022.
2. "Software" for electronic devices, even when residing in an electronic device or system, enabling such devices or systems to function as a "numerical control" unit, capable of coordinating simultaneously more than 4 axes for "contouring control".

Note:

1024.2. does not control "software" specially designed or modified for the operation of machine tools not controlled by Category 1020.

1025. Technology

1. "Technology" according to the General Technology Note for the "development" of equipment or "software" controlled by 1021., 1022. or 1024.
2. "Technology" according to the General Technology Note for the "production" of equipment controlled by 1021. or 1022.
3. Other technology, as follows:
   a. "Technology" for the "development" of interactive graphics as an integrated part in "numerical control" units for preparation or modification of part programmes;
   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"; **or**
         c. "Direct-acting hydraulic pressing";
      2. Technical data consisting of process methods or parameters as listed below used to control:
         a. "Superplastic forming" of aluminum 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 aluminum alloys or titanium alloys:
            1. Pressure;
            2. Cycle time;
         d. "Hot isostatic densification" of titanium alloys, aluminum alloys or "superalloys":
            1. Temperature;
            2. Pressure;
            3. Cycle time;
   c. "Technology" for the "development" or "production" of hydraulic stretch-forming machines and dies therefore, for the manufacture of airframe structures;
   d. "Technology" for the "development" of generators of machine tool instructions (e.g., part programmes) from design data residing inside "numerical control" units;
   e. "Technology" for the "development" of integration "software" for incorporation of expert systems for advanced decision support of shop floor operations into "numerical control" units;
   f. "Technology" for the application of inorganic overlay coatings or inorganic surface modification coatings (specified in column 3 of the following Table) to non-electronic substrates (specified in column 2 of the following table), by processes specified in column 1 of the following table and defined in the Technical Note.

N.B.:

This Table should be read to control the technology of a particular 'Coating Process' only when the 'Resultant Coating' in column 3 is in a paragraph directly across from the relevant 'Substrate' under column 2. For example, Chemical Vapour Deposition (CVD) coating process technical data are controlled for the application of 'silicides' to 'Carbon-carbon, Ceramic and Metal "matrix" "composites"' substrates, but are not controlled for the application of 'silicides' to 'Cemented tungsten carbide (16), Silicon carbide (18)' substrates. In the second case, the 'Resultant Coating' is not listed in the paragraph under column 3 directly across from the paragraph under column 2 listing 'Cemented tungsten carbide (16), Silicon carbide (18)'.

Table - Deposition Techniques

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

** **Note:** The numbers in brackets refer to the Notes following this table.*

Table - Deposition Techniques

Coating Process (1)*	Substrate	Resultant Coating
B. 1. Physical VapourDeposition (PVD): Electron-Beam (EB-PVD) Con't:	Cemented tungsten carbide (16), Silicon carbide (18)	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15) Borides Beryllium
	Sensor window materials (9)	Dielectric layers (15)
	Titanium alloys (13)	Borides Nitrides
B. 2. Ion assisted resistive heating Physical Vapour Deposition (PVD) (Ion Plating)	Ceramics (19) and Low-expansion glasses (14)	Dielectric layers (15) Diamond-like carbon (17)
	Carbon-carbon, Ceramic and Metal "matrix""composites"	Dielectric layers (15)
	Cemented tungsten carbide (16), Silicon carbide	Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15)
	Sensor window materials (9)	Dielectric layers (15) Diamond-like carbon (17)
B. 3. Physical Vapour Deposition (PVD): "Laser" Vaporization	Ceramics (19) and Low-expansion glasses (14)	Silicides Dielectric layers (15) Diamond-like carbon (17)
	Carbon-carbon, Ceramic and Metal "matrix""composites"	Dielectric layers (15)
	Cemented tungsten carbide (16), Silicon carbide	Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15)
	Sensor window materials (9)	Dielectric layers (15) Diamond-like carbon
B. 4. Physical Vapour Deposition (PVD): Cathodic Arc Discharge	"Superalloys"	Alloyed silicides Alloyed aluminides (2) MCrAlX (5)
	Polymers (11) and Organic "matrix" "composites"	Borides Carbides Nitrides Diamond-like carbon (17)

** **Note:** The numbers in brackets refer to the Notes following this table.*

Table - Deposition Techniques

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

** **Note:** The numbers in brackets refer to the Notes following this table.*

Table - Deposition Techniques

Coating Process (1)*	Substrate	Resultant Coating
F. Sputter Deposition (con't)	Ceramics and Low-expansion glasses (14)	Silicides Platinum Mixtures thereof (4) Dielectic layers (15) Diamond-like carbon (17)
	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) Boron nitride
	Cemented tungsten carbide (16), Silicon carbide (18)	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15) Boron nitride
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Borides Dielectric layers (15) Beryllium
	Sensor window materials (9)	Dielectric layers (15) Diamond-like carbon (17)
	Refractory metals and alloys (8)	Aluminides Silicides Oxides Carbides
G. Ion Implantation	High temperature bearing steels	Additions of Chromium, Tantalum or Niobium (Columbium)
	Titanium alloys (13)	Borides Nitrides
	Beryllium and Beryllium alloys	Borides
	Cemented tungsten carbide (16)	Carbides Nitrides

** **Note:** The numbers in brackets 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. *The term 'mixtures thereof' includes infiltrated material, graded compositions, co-deposits and multilayer deposits and are obtained by one or more of the coating processes specified in the Table.*
5. *MCrAlX refers to a coating alloy where M equals cobalt, iron, nickel or combinations thereof and X equals hafnium, yttrium, silicon, tantalum in any amount or other intentional additions over 0.01 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 aluminum 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 aluminum 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 aluminum and 0.9 to1.1 weight percent of yttrium.*
6. *The term 'aluminum alloys' refers to alloys having an ultimate tensile strength of 190 MPa or more measured at 293 K (20°C).*
7. *The term 'corrosion resistant steel' refers to AISI (American Iron and Steel Institute) 300 series or equivalent national standard steels.*
8. *'Refractory metals and alloys' include the following metals and their alloys: niobium (columbium), molybdenum, tungsten and tantalum.*
9. *'Sensor window materials', as follows: alumina, silicon, germanium, zinc sulphide, zinc selenide, gallium arsenide, diamond, gallium phosphide, sapphire and the following metal halides: sensor window materials of more than 40 mm diameter zirconium fluoride and hafnium fluoride.*
10. *Technology for single-step pack cementation of solid airfoils is not controlled 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) 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 controlled.*
13. *'Titanium alloys' refers only to aerospace alloys having an ultimate tensile strength of 900 MPa or more measured at 293 K (20°C).*
14. *'Low-expansion glasses' refers to glasses which have a coefficient of thermal expansion of 1 x 10^{-7} K^{-1} or less measured at 293 K (20°C).*
15. *'Dielectric layers' are coatings constructed of multi-layers of insulator materials in which the interference properties of a design composed of materials of various refractive indices are used to reflect, transmit or absorb various wavelength bands. Dielectric layers refers to more than four dielectric layers or dielectric/metal "composite" layers.*
16. *'Cemented tungsten carbide' does not include cutting and forming tool materials consisting of tungsten carbide/(cobalt, nickel), titanium carbide/(cobalt, nickel), chromium carbide/nickel-chromium and chromium carbide/nickel.*
17. *"Technology" specially designed to deposit diamond-like carbon on any of the following is not controlled: magnetic disk drives and heads, polycarbonate eyeglasses, equipment for the manufacture of disposables, bakery equipment, valves for faucets, acoustic diaphragms for speakers, engine parts for automobiles, cutting tools, punching-pressing dies, high quality lenses designed for cameras or telescopes, office automation equipment, microphones or medical devices.*
18. *'Silicon carbide' does not include cutting and forming tool materials.*
19. *Ceramic substrates, as used in this entry, does not include ceramic materials containing 5% by weight, or greater, clay or cement content, either as separate constituents or in combination.*

Technical 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 deposition (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 vaporise 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 synthesise compound coatings is an ordinary modification of the process.
   The use of ion or electron beams, or plasma, to activate or assist the coating's deposition is also a common modification in this technique. The use of monitors to provide in-process measurement of optical characteristics and thickness of coatings can be a feature of these processes.
   Specific TE-PVD processes are as follows:
   1. *Electron Beam PVD uses an electron beam to heat and evaporate the material which forms the coating;*
   2. *Ion Assisted Resistive Heating PVD employs electrically resistive heating sources in combination with impinging ion beam(s) to produce a controlled and uniform flux of evaporated coating species;*
   3. *"Laser" Vaporization uses either pulsed or continuous wave "laser" beams to vaporise 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 ionised 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.
   5. *Ion Plating is a special modification of a general TE-PVD process in which a plasma or an ion source is used to ionise the species to be deposited, and a negative bias is applied to the substrate in order to facilitate the extraction of the species from the plasma. The introduction of reactive species, evaporation of solids within the process chamber, and the use of monitors to provide in-process measurement of optical characteristics and thicknesses of coatings are ordinary modifications of the process.*

c. *Pack Cementation is a surface modification coating or overlay coating process wherein a substrate is immersed in a powder mixture (a pack), that consists of:*
   1. *The metallic powders that are to be deposited (usually aluminum, chromium, silicon or combinations thereof);*
   2. *An activator (normally a halide salt);* ***and***
   3. *An inert powder, most frequently alumina.*
   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.

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

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

Technical Notes to Table - Deposition Techniques(Con't):

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

g. Ion Implantation is a surface modification coating process in which the element to be alloyed is ionised, accelerated through a potential gradient and implanted into the surface region of the substrate. 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;
4. Application of binders to promote adhesion;
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;
f. Control of composition;

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 (measured as a function of wavelength):
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 (CVD):
1. Coating source composition and formulation;
2. Carrier gas composition;
3. Substrate temperature;
4. Time-temperature-pressure cycles;
5. Gas control and part manipulation
b. For Thermal Evaporation - Physical Vapour Deposition (PVD):
1. Ingot or coating material source composition;
2. Substrate temperature;
3. Reactive gas composition;
4. Ingot feed rate or material vaporization rate;
5. Time-temperature-pressure cycles;
6. Beam and part manipulation;
7. "Laser" parameters, as follows:
a. Wave length;
b. Power density;
c. Pulse length;
d. Repetition ratio;
e. Source;
c. For Pack Cementation:
1. Pack composition and formulation;
2. Carrier gas composition;
3. Time-temperature-pressure cycles;
d. For Plasma Spraying:
1. Powder composition, preparation and size distributions;
2. Feed gas composition and parameters;
3. Substrate temperature;
4. Gun power parameters;
5. Spray distance;
6. Spray angle;
7. Cover gas composition, pressure and flow rates;
8. Gun control and part manipulation;
e. For Sputter Deposition:
1. Target composition and fabrication;
2. Geometrical positioning of part and target;
3. Reactive gas composition;
4. Electrical bias;
5. Time-temperature-pressure cycles;
6. Triode power;
7. Part manipulation;
f. For Ion Implantation:
1. Beam control and part manipulation;
2. Ion source design details;
3. Control techniques for ion beam and deposition rate parameters;
4. Time-temperature-pressure cycles;
g. For Ion Plating:
1. Beam control and part manipulation;
2. Ion source design details;
3. Control techniques for ion beam and deposition rate parameters;
4. Time-temperature-pressure cycles;
5. Coating material feed rate and vaporization rate;
6. Substrate temperature;
7 Substrate bias parameters.

Category 1030: Electronics

1031. Systems, Equipment and Components

Notes:

1. *The control status of equipment and components described in 1031., other than those described in 1031.1.a.3. to 1031.1.a.10. or 1031.1.a.11., which are specially designed for or which have the same functional characteristics as other equipment is determined by the control status of the other equipment.*
2. *The control status of integrated circuits described in 1031.1.a.3. to 1031.1.a.9. or 1031.1.a.11. which are unalterably programmed or designed for a specific function for another equipment is determined by the control status of the other equipment.*

   N.B.:

   When the manufacturer or applicant cannot determine the control status of the other equipment, the control status of the integrated circuits is determined in 1031.1.a.3. to 1031.1.a.9. or 1031.1.a.11.

   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 control status of the integrated circuit is determined in 1031.1.a.3.

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

      Notes:

      1. *The control 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. Integrated circuits, designed or rated as radiation hardened to withstand any of the following:
         a. A total dose of 5×10^3 Gy (Si) or higher; **or**
         b. A dose rate upset of 5×10^6 Gy (Si)/s or higher;
      2. "Microprocessor microcircuits", "microcomputer microcircuits", microcontroller microcircuits, storage integrated circuits manufactured from a compound semiconductor, analogue-to-digital converters, digital-to-analogue converters, electro-optical or "optical integrated circuits" designed for "signal processing", field programmable logic devices, neural network integrated circuits, custom integrated circuits for which either the function is unknown or the control status of the equipment in which the integrated circuit will be used is unknown, Fast Fourier Transform (FFT) processors, electrical erasable programmable read-only memories (EEPROMs), flash memories or static random-access memories (SRAMs), having any of the following:
         a. 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.

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

         Note:

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

         a. A "composite theoretical performance" ("CTP") of 6,500 million theoretical operations per second (Mtops) or more and an arithmetic logic unit with an access width of 32 bits 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 150 Mbyte/s;
      4. 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 of less than 5 ns;
            2. A resolution of 12 bit with a total conversion time of less than 200 ns; **or**
            3. A resolution of more than 12 bit with a total conversion time of less than 2^n;

            Technical Note:

            1. *A resolution of n bit corresponds to a resolution of 2^n levels*
            2. *Total conversion time is the inverse of the sample rate.*

      6. Electro-optical and "optical integrated circuits" designed for "signal processing" having all of the following:
         a. One or more than one internal "laser" diode;
         b. One or more than one internal light detecting element; **and**
         c. Optical waveguides;
      7. Field programmable logic devices having any of the following:
         a. An equivalent usable gate count of more than 30,000 (2 input gates);
         b. A typical "basic gate propagation delay time" of less than 0.1 ns; **or**
         c. A toggle frequency exceeding 133 MHz;

         Note:1031.1.a.7. includes

         - *Simple Programmable Logic Devices (SPLDs)*
         - *Complex Programmable Logic Devices (CPLDs)*
         - *Field Programmable Gate Arrays (FPGAs)*
         - *Field Programmable Logic Arrays (FPLAs)*
         - *Field Programmable Interconnects (FPICs)*

         N.B.

         Field Programmable logic devices are also known as field programmable logic arrays.

      8. Neural network integrated circuits;
      9. Custom integrated circuits for which the function is unknown, or the control status of the equipment in which the integrated circuits will be used is unknown to the manufacturer, having any of the following:
         a. More than 1000 terminals;

1031.1.a.9. con't.

b. A typical "basic gate propagation delay time" of less than 0.1 ns; **or**

c. An operating frequency exceeding 3 GHz;

10. Digital integrated circuits, other than those described in 1031.1.a.3. to 1031.1.a.9. or 1031.1.a.11., based upon any compound semiconductor and having any of the following:
    a. An equivalent gate count of more than 3000 (2 input gates); **or**
    b. A toggle frequency exceeding 1.2 GHz;
11. Fast Fourier Transform (FFT) processors having a rated execution time for an N-point complex FFT of less than $(N \log_2 N)/20{,}480$ ms, where N is the number of points;

Technical Note

When N is equal to 1,024 points, the formula in 1031.1.a.11. gives an execution time of 500 µs.

1. b. Microwave or millimetre wave components, as follows:
    1. Electronic vacuum tubes and cathodes, as follows:

Note 1:

1031.1.b.1. does not control tubes designed or rated for operation in any frequency band which meets all of the following characteristics:

*a. Does not exceed 31 GHz; **and***

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

Note 2

1031.1.b.1. does not control non-"space-qualified" tubes which meet all of the following characteristics:

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

b. Designed or rated for operation in any frequency band which meets all of the following characteristics:

*1. Exceeds 31 GHz but does not exceed 43.5 GHz; **and***

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

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 a "fractional 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. Being "space qualified";

b. Crossed-field amplifier tubes with a gain of more than 17 dB;

c. Impregnated cathodes designed for electronic tubes producing a continuous emission current density at rated operating conditions exceeding 5 A/cm ^{2} ;

2. Microwave integrated circuits or modules having all of the following:
    a. Containing "monolithic integrated circuits" having one or more active circuit elements; **and**
    b. Operating at frequencies exceeding 3 GHz;

Note 1:

1031.1.b.2. does not control circuits or modules for equipment designed or rated for operation in any frequency band which meets all of the following characteristics:

*a. Does not exceed 31 GHz; **and***

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

Note 2:

1031.1.b.2. does not control broadcast satellite equipment designed or rated to operate in the frequency range of 40.5 to 42.5 GHz.

3. Microwave transistors rated for operation at frequencies exceeding 31 GHz;
4. Microwave solid state amplifiers, having any of the following:
    a. Operating frequencies exceeding 10.5 GHz and an "instantaneous bandwidth" of more than half an octave; **or**
    b. Operating 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 having any of the following:
    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;
8. Microwave power amplifiers containing tubes controlled by 1031.1.b. and having all of the following:
    a. Operating frequencies above 3 GHz;
    b. An average output power density exceeding 80 W/kg; **and**
    c. A volume of less than 400 cm^3;

Note:

1031.1.b.8. does not control equipment designed or rated for operation in any frequency band which is "allocated by the ITU" for radio-communications services, but not for radio-determination.

1. c. Acoustic wave devices, as follows, and specially designed components therefore:
    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 exceeding 1 GHz but not exceeding 2.5 GHz, and having any of the following:
            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;
            3. A bandwidth greater than 250 MHz; **or**
            4. A dispersive delay of more than 10 µs; **or**
        c) A carrier frequency 1 GHz or less, having any of the following:
            1. A product of the maximum delay time and the bandwidth (time in µs and bandwidth in MHz) of more than 100;

1031.1.c.1.c. con't.

2. A dispersive delay of more than 10 μs; **or**
3. A frequency side-lobe rejection exceeding 55 dB and a bandwidth greater than 50 MHz;

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;

1. d. Electronic devices and circuits containing components, manufactured from "superconductive" materials specially designed for operation at temperatures below the "critical temperature" of at least one of the "superconductive" constituents, with any of the following:
   1. Current switching for digital circuits using "superconductive" gates with a product of delay time per gate (in seconds) and power dissipation per gate (in watts) of less than 10^{-14} J; **or**
   2. Frequency selection at all frequencies using resonant circuits with Q-values exceeding 10,000;

1. e. High energy devices, as follows:
   1. Batteries and photovoltaic arrays, as follows:

Note:
1031.1.e.1. does not control batteries with volumes equal to or less than 27 cm3 (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^2 at an operating temperature of 301 K (28°C) under a tungsten illumination of 1 kW/m2 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 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 and 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 control "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^2 ;

1. f. Rotary input type shaft absolute position encoders having any 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 ± 2.5 seconds of arc.

2. General purpose electronic equipment, as follows:
   a. Recording equipment, as follows, and specially designed test tape therefore:
      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 ± 0.1 μs;

Note:
Analogue magnetic tape recorders specially designed for civilian video purposes are not considered to be instrumentation tape recorders.

      2. Digital video magnetic tape recorders having a maximum digital interface transfer rate exceeding 360 Mbit/s;

Note:
1031.2.a.2. does not control digital video magnetic tape recorders specially designed for television recording using a signal format, which may include a compressed signal format, standardised or recommended by the ITU, the IEC, the SMPTE, the EBU or the IEEE for civil television applications.

2. a. 3. Digital instrumentation magnetic tape data recorders employing helical scan techniques or fixed head techniques, having any of the following:
   a. A maximum digital interface transfer rate exceeding 175 Mbit/s; **or**
   b. Being "space qualified";

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

1031.1.a.9. con't.

4. Equipment, having 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 having all of the following:
   a. Digitizing 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 Gbit/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.

2. b. "Frequency synthesiser" "electronic assemblies" having a "frequency switching time" from one selected frequency to another of less than 1 ms;
   c. Radio frequency "Signal analyzers", as follows:
      1. "Signal analyzers" capable of analyzing frequencies exceeding 31 GHz;
      2. "Dynamic signal analyzers" having a "real-time bandwidth" exceeding 500 kHz;

      Note:
      1031.2.c.2. does not control those "dynamic signal analyzers" 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 control equipment in which the output frequency is either produced by the addition or subtraction of two or more crystal oscillator frequencies, or by an addition or subtraction followed by a multiplication of the result.

   e. Network analyzers with a maximum operating frequency exceeding 40 GHz;
   f. Microwave test receivers having all of the following:
      1. A maximum operating frequency exceeding 40 GHz; **and**
      2. Being capable of measuring amplitude and phase simultaneously;
   g. Atomic frequency standards having any of the following:
      1. Long term stability (aging) less (better) than 1 x 10^{-11} /month; **or**
      2. Being "space qualified".

      Note:
      1031.2.g.1. does not control non-"space qualified" rubidium standards.

1032. Test, Inspection and Production Equipment

1. Equipment for the manufacturing of semiconductor devices or materials, as follows, and specially designed components and accessories therefore:
   a. "Stored programme controlled" equipment designed for epitaxial growth, as follows:
      1. Equipment capable of producing a layer thickness uniform to less than ± 2.5% across a distance of 75 mm or more;
      2. Metal organic chemical vapour deposition (MOCVD) reactors specially designed for compound semiconductor crystal growth by the chemical reaction between materials controlled by 1033.3. or 1033.4.;
      3. Molecular beam epitaxial growth equipment using gas or solid sources;
   b. "Stored programme controlled" equipment designed for ion implantation, having any of the following:
      1. A beam energy (accelerating voltage) exceeding 1 MeV;
      2. Being specially designed and optimised to operate at a beam energy (accelerating voltage) of less than 2 keV;
      3. Direct write capability; **or**
      4. Being capable of high energy oxygen implant into a heated semiconductor material "substrate";
   c. "Stored programme controlled" anisotropic plasma dry etching equipment, as follows:
      1. Equipment with cassette-to-cassette operation and load-locks, and having any of the following:
         a. Designed or optimised to produce critical dimensions of 0.3 µm or less with ±5% 3 sigma precision; **or**
         b. Designed for generating less than 0.04 particles/cm^2 with a measurable particle size greater than 0.1 µm in diameter;
      2. Equipment specially designed for equipment controlled by 1032.1.e. and having any of the following:
         a. Designed or optimised to produce critical dimensions of 0.3 µm or less with ±5% 3 sigma precision; **or**
         b. Designed for generating less than 0.04 particles/cm^2 with a measurable particle size greater than 0.1 µm in diameter;
   d. "Stored programme controlled" plasma enhanced CVD equipment, as follows:
      1. Equipment with cassette-to-cassette operation and load-locks, and having any of the following:
         a. Designed according to the manufacturer's specifications or optimised to produce critical dimensions of 0.3 µm or less with ±5% 3 sigma precision; **or**
         b. Designed for generating less than 0.04 particles/cm^2 with a measurable particle size greater than 0.1 µm in diameter;
      2. Equipment specially designed for equipment controlled by 1032.1.e. and having any of the following:
         a. Designed according to the manufacturer's specifications or optimised to produce critical dimensions of 0.3 µm or less with ±5% 3 sigma precision; **or**
         b. Designed for generating less than 0.04 particles/cm^2 with a measurable particle size greater than 0.1 µm in diameter;
1. e. "Stored programme controlled" automatic loading multi-chamber central wafer handling systems, having all of the following:

1032.1.e. con't.

1. Interfaces for wafer input and output, to which more than two pieces of semiconductor processing equipment are to be connected; **and**
2. Designed to form an integrated system in a vacuum environment for sequential multiple wafer processing;

Note:
1032.1.e. does not control automatic robotic wafer handling systems not designed to operate in a vacuum environment.

f. "Stored programme controlled" lithography equipment, as follows:
   1. Align and expose step and repeat (direct step on wafer) or step and scan (scanner) equipment for wafer processing using photo-optical or X-ray methods, having any of the following:
      a. A light source wavelength shorter than 350 nm; **or**
      b. Capable of producing a pattern with a minimum resolvable feature size of 0.5 µm or less;

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

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

      where the K factor = 0.7.
      MRF = minimum resolvable feature size.

   2. Equipment specially designed for mask making or semiconductor device processing using deflected focussed electron beam, ion beam or "laser" beam, having any of the following:
      a. A spot size smaller than 0.2 µm;
      b. Being capable of producing a pattern with a feature size of less than 1 µm; **or**
      c. An overlay accuracy of better than ± 0.20 µm (3 sigma.;
g. Masks and reticles designed for integrated circuits controlled by 1031.1.;
h. Multi-layer masks with a phase shift layer.

2. "Stored programme controlled" test equipment, specially designed for testing finished or unfinished semiconductor devices, as follows, and specially designed components and accessories therefore:
   a. For testing S-parameters of transistor devices at frequencies exceeding 31 GHz;
   b. For testing integrated circuits capable of performing functional (truth table) testing at a pattern rate of more than 333 MHz;

   Note:
   1032.2.b. does not control test equipment specially designed for testing:
   1 "Electronic assemblies" or a class of "electronic assemblies" for home or entertainment applications;
   2. Uncontrolled electronic components, "electronic assemblies" or integrated circuits.
   3. Memories

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

   c. For testing microwave integrated circuits controlled by 1032.2.b.

1033. Materials

1. Hetero-epitaxial materials consisting of a "substrate" with stacked epitaxially grown multiple layers of any of the following:
   a. Silicon;
   b. Germanium; **or**
   c. Silicon Carbide;
   d. 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 Mendeleyev's periodic classification table (e.g., gallium arsenide, gallium-aluminum arsenide, indium phosphide).

2. Resist materials, as follows, and "substrates" coated with controlled resists:
   a. Positive resists designed for semiconductor lithography specially adjusted (optimised) for use at wavelengths below 350 nm ;
   b. All resists, designed for use with electron beams or ion beams, with a sensitivity of 0.01 µcoulomb/mm^2 or better;
   c. All resists, designed for use with X-rays, with a sensitivity of 2.5 mJ/mm^2 or better;
   d. All resists optimised 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 aluminum, 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 controls 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 control hydrides containing 20% molar or more of inert gases or hydrogen.

1034. Software

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

1034.3.notes con't.

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 1:

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

Note 2:

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 controlled by 1031., 1032. or 1033.
2. "Technology" according to the General Technology Note other than that controlled in 1035.1 for the "development" or "production" of "microprocessor microcircuits", "microcomputer microcircuits" and microcontroller microcircuits having a "composite theoretical performance" ("CTP") of 530 million theoretical operations per second (Mtops) or more and an arithmetic logic unit with an access width of 32 bits or more.

   Note 1:

   1035.1. and 1035.3.g. do not control "technology" for the "development" or "production" of:

   a. Microwave transistors operating at frequencies below 31 GHz;

   b. Integrated circuits controlled by 1031.1.a.3. to 1031.1.a.11. having all of the following:

   1. Using "technology" of 0.7 µm or more, and

   2. Not incorporating multi-layer structures.

   Technical Note:

   The term multi-layer structures in Note b.2. above does not include devices incorporating a maximum of three metal layers and three polysilicon layers.

   Note 2:

   The definition "Allocated by the ITU" will alsways reflect the current edition of the ITU Radio Regulations.

3. 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 and super lattice devices;
   c. "Superconductive" electronic devices;
   d. Substrates of films of diamond for electronic components;
   e. Substrates of silicon-on-insulator (SOI) for integrated circuits in which the insulator is silicon dioxide;
   f. Substrates of silicon carbide for electronic components;
   g. Electronic vacuum tubes operating at frequencies of 31 GHz or higher.

Category 1040: Computers

Note 1:

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

Note2:

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).

N.B.

For the control status of "software" specially designed for packet switching, see Category 1054.(Telecommunications).

Note 3:

Computers, related equipment and "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 1150. (Information Security).

1041. Systems, Equipment and Components

1. Electronic computers and related equipment, as follows, and "electronic assemblies" and specially designed components therefore:
   a. Specially designed to have any of the following characteristics:
      1. 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.

      2. Radiation hardened to exceed any of the following specifications:
         a. Total Dose 5 x 10 3 Gy (Si);
         b. Dose Rate Upset 5 x 10 6 Gy (Si)/sec; **or**
         c. Single Event Upset 1 x 10 -7 Error/bit/day;

         N.B.:

         For equipment designed or rated for transient ionizing radiation, see Group 2, Munitions List.

   b. Having characteristics or performing functions exceeding the limits in Category 1150 (Information Security).

      Note:

      1041.1.b. does not control electronic computers and related equipment when accompanying their user for the user's personal use.

2. "Hybrid computers", as follows, and "electronic assemblies" and specially designed components therefore:
   a. Containing "digital computers" controlled by 1041.3.;
   b. Containing analogue-to-digital converters having all of the following characteristics:
      1. 32 channels or more; **and**
      2. A resolution of 14 bits (plus sign bit) or more with a conversion rate of 200,000 conversions/s or more.
      3. "Digital computers", "electronic assemblies", and related equipment therefore, as follows, and specially designed components therefore:

         Notes:

         1. 1041.3. includes the following:

         a. vector processors;

         b. array processors;

         c. digital signal processors;

         d. logic processors;

         e. Equipment designed for image enhancement;

         f. Equipment designed for "signal processing".

         2. The control status of the "digital computers" and related equipment described in 1041.3. is determined by the control status of other equipment or systems provided:

         a. The "digital computers" or related equipment are essential for the operation of the other equipment or systems;

         *b. The "digital computers" or related equipment are not a "principal element" of the other equipment or systems; **and***

1041.2.b.2. notes con't.

N.B.:

1. *The control status of "signal processing" or "image enhancement" equipment specially designed for other equipment with functions limited to those required for the other equipment is determined by the control status of the other equipment even if it exceeds the "principal element" criterion.*
2. *For the control status of "digital computers" or related equipment for telecommunications equipment, see Category 1050 (Telecommunications).*

c. *The technology for the "digital computers" and related equipment is determined by 1045.*

3. a. 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 utilise any of the following:

1. *Error detection or correction algorithms in "main storage";*
2. *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;*
3. *The interconnection of two central processing units by data channels or by using 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***
4. *The synchronization 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.*

b. "Digital computers" having a "composite theoretical performance" ("CTP") exceeding 28,000 Mtops;

c. "Electronic assemblies" specially designed or modified for enhancing performance by aggregation of "computing elements' ("CEs") so that the "CTP" of the aggregation exceeds the limit in 1041.3.b.;

Note 1:

1041.3.c. applies only to "electronic assemblies" and programmable interconnections not exceeding the limit in 1041.3.b. when shipped as unintegrated "electronic assemblies". It does not apply to "electronic assemblies" inherently limited by nature of their design for use as related equipment controlled by 1041.3.d., or 1041.3.e.

Note 2:

1041.3.c. does not control "electronic assemblies" specially designed for a product or family of products whose maximum configuration does not exceed the limit of 1041.3.b.

d. Deleted

e. Equipment performing analogue-to-digital conversions exceeding the limits in 1031.1.a.5.;

f. Deleted

g. Equipment specially designed to provide external interconnection of "digital computers" or associated equipment which allows communications at data rates exceeding 1.25 Gbyte/s.

Note:

1041.3.g. does not control internal interconnection equipment (e.g., backplanes, buses), passive interconnection equipment, "network access controllers" or "communication channel controllers".

4. Computers, as follows, and specially designed related equipment, "electronic assemblies" and components therefore:
   a. "Systolic array computers";
   b. "Neural computers";
   c. "Optical computers".

1042. Test, Inspection and Production Equipment

None.

1043. Materials

None.

1044. Software

Note:

The control status of "software" for the "development", "production", or "use" of equipment described in other Categories is dealt with in the appropriate Category. The control 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" controlled by 1041. or 1044.
2. "Software" specially designed or modified to support "technology" controlled 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. "Software" having characteristics or performing functions exceeding the limits in Category 1150 (Information Security);

Note:

1044.3.b. does not control "software" when accompanying its user for the user's personal use.

1045. Technology

1. "Technology" according to the General Technology Note, for the "development", "production" or "use" of equipment or "software" controlled by 1041. or 1044.

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.*

Technical Note on "Composite Theoretical Performance" (Con't):

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.

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:

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

"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:

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

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

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

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

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: Note: Every "CE" must be evaluated independently	Effective calculating Rate, R

XP only
 	
(R_{xp})
	$\frac{1}{3 * (t_{xp\ add})}$
	
	if no add is implemented use:
	$\frac{1}{(t_{xp\ mult})}$
	
	if neither add nor multiply is implemented use the fastest available arithmetic operation as follows:
	$\frac{1}{3 * t_{xp}}$
	
	See Notes X and Z.

FP Only (R_{fp})	$\textbf{max}\ \frac{1}{t_{xp\ add}}\ ,\ \frac{1}{t_{fp\ mult}}$ See Notes X and Y.
Both FP and XP (R)	Calculate both R xp, R fp
For simple logic processors not implementing any of the specified arithmetic operations.	$\frac{1}{3 * t_{log}}$ Where t log is the execute time of the XOR, or for logic hardware not implementing the XOR, the fastest simple logic operation. See Notes X and 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 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.

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 * L
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 specialised 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",

"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 utilizing specially designed hardware.*
   This aggregation does not apply to "electronic assemblies" described by 1041.3.c.

   "CTP" = $TP_1 + C_2 * TP_2 + ... + C_n * TP_n$,

   where the TPs 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:
$C_2 = C_3 = C_4 = ... = C_n = 0.75$

Notes:

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

   $Ci = \frac{0.75}{\sqrt{m}}$ *(i = 2, ... , n)*

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

   a. *The TPi 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:
*Ci = 0.75 * k_i (i = 2, ... , 32) (see Note below)*
*= 0.60 * k_i (i = 33, ... , 64)*
*= 0.45 * k_i (i = 65, ... , 256)*
*= 0.30 * k_i (i > 256)*
The value of C i is based on the number of "Ces", not the number of nodes.
where k_i = *min (S_i / K_r , 1), and*
K_r = *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^{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"$_{64}$, "CE"$_{65}$ and "CE"$_{66}$ The proper limit for Ci for this group is 0.60.

Aggregation (of "CEs" or groups of "CEs") should be from the fastest-to-slowest; i.e.:
$TP_1 \geq TP_2 \geq .... \geq TP\ n$, *and*
in the case of $TP_i = TP_i + 1$, from the largest to smallest; i.e., : $C_i \geq C_i + 1$

Note:
The ki factor is not to be applied to "CEs" 2 to 12 if the TPi of the "CE" or group of "CEs" is more than 50 Mtops; i.e., C_i for "CEs" 2 to 12 is 0.75.

Category 1050: Telecommunications

Notes:

1. *The control status of components, "lasers", test and production equipment, and "software" therefore which are specially designed for telecommunications equipment or systems is determined in Category 1050.*
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. Systems, Equipment, and Components

1. Any type of telecommunications equipment having any of the following characteristics, functions or features:
   a. Specially designed to withstand transitory electronic effects or electromagnetic pulse effects arising from a nuclear explosion;
   b. Specially hardened to withstand gamma, neutron or ion radiation; **or**
   c. Specially designed to operate outside the temperature range from 218 K (-55°C) to 397 K (124°C).
   Note:
   1051.1.c. applies only to electronic equipment.
   Note:
   1051.1.b. and 1051.1.c. do not control equipment designed or modified for use on board satellites.

2. Telecommunication transmission equipment and systems, and specially designed components and accessories therefore, having any of the following characteristics, functions or features:
   a. Being underwater communications systems having any of the following characteristics:
      1. An acoustic carrier frequency outside the range from 20 kHz to 60 kHz;
      2. Using an electromagnetic carrier frequency below 30 kHz; **or**
      3. Using electronic beam steering techniques;
   b. Being radio equipment operating in the 1.5 to 87.5 MHz band and having any of the following characteristics:
      1. Incorporating adaptive techniques providing more than 15 dB suppression of an interfering signal; **or**
      2. Having all of the following:
         a. Automatically predicting and selecting frequencies and "total digital transfer rates" per channel to optimise the transmission; **and**
         b. Incorporating a linear power amplifier configuration having a capability to support multiple signals simultaneously at an output power of 1 kW or more in the 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;
   c. Being radio equipment employing "spread spectrum" techniques, including "frequency hopping" techniques, having any of the following characteristics:
      1. User programmable spreading codes; **or**
      2. A total transmitted bandwidth which is 100 or more times the bandwidth of any one information channel and in excess of 50 kHz.
      Note:
      1051.2.c.2. does not control radio equipment specially designed for use with civil cellular radio-communications systems.
   Note:
   1051.2.c. does not control equipment designed to operate at an output power of 1.0 Watt or less.
   d. Being radio equipment employing "time-modulated ultra-wideband" techniques, having user programmable channelizing or scrambling codes;
   e. Being digitally controlled radio receivers having all of the following:
      1. More than 1,000 channels;
      2. A "frequency switching time" of less than 1 ms;
      3. Automatic searching or scanning of a part of the electromagnetic spectrum; **and**
      4. Identification of the received signals or the type of transmitter; **or**
      Note:
      1051.2.e. does not control radio equipment specially designed for use with civil cellular radio-communications systems
   f. Employing functions of digital "signal processing" to provide voice coding at rates of less than 2,400 bits/s.
3. Optical fibre communication cables, optical fibres and accessories, as follows:
   a. Optical fibres of more than 500 m in length specified by the manufacturer as being capable of withstanding a proof test tensile stress of 2 x 109 N/m2 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%. Equivalent national standards may be used for executing the proof test.
   b. Optical fibre cables and accessories designed for underwater use.
   Note:
   1051.3.b. does not control standard civil telecommunication cables and accessories.
   N.B.1:
   For underwater umbilical cables, and connectors therefore, see 1081.2.a.3.
   N.B.2:
   For fibre-optic hull penetrators or connectors, see 1081.2.c.

4. "Electronically steerable phased array antennae" operating above 31 GHz.
   Note:
   1051.4. does not control "electronically steerable phased array antennae" for landing systems with instruments meeting ICAO standards covering microwave landing systems (MLS).

1052. Test, Inspection and Production Equipment

1. Equipment and specially designed components or accessories therefore, specially designed for the "development", "production" or "use" of equipment, functions or features controlled by Category 1050.
   Note:
   1052.1. does not control optical fibre characterization equipment.
2. Equipment and specially designed components or accessories therefore, specially designed for the "development" of any of the following telecommunication transmission or "stored programme controlled" switching equipment:

1052.2. con't.

a. Equipment employing digital techniques, including "Asynchronous Transfer Mode" ("ATM"), designed to operate at a "total digital transfer rate" exceeding 1.5 Gbit/s;
b. Equipment employing a "laser" and having any of the following:
   1. A transmission wavelength exceeding 1750 nm;
   2. Performing "optical amplification";
   3. Employing coherent optical transmission or coherent optical detection techniques (also called optical heterodyne or homodyne techniques); **or**
   4. Employing analogue techniques and having a bandwidth exceeding 2.5 GHz;
   Note:
   1052.2.b.4. does not control equipment specially designed for the "development" of commercial TV systems.
c. Equipment employing "optical switching";
d. Radio equipment employing quadrature-amplitude-modulation (QAM) techniques above level 128:
e. Equipment employing "common channel signalling" operating in either non-associated or quasi- associated mode of operation.

1053. Materials

None.

1054. Software

1. "Software" specially designed or modified for the "development", "production" or "use" of equipment, functions or features controlled by Category 1050.
2. "Software" specially designed or modified to support "technology" controlled by 1055.
3. Specific "software" as follows:
   a. "Software" specially designed or modified to provide characteristics, functions or features of equipment controlled by 1051. or 1052.;
   b. "Software", other than in machine-executable form, specially designed for "dymanic adaptive routing".
4. "Software" specially designed or modified for the "development" of any of the following telecommunication transmission or "stored programme controlled" switching equipment:
   a. Equipment employing digital techniques, including "Asynchronous Transfer Mode" ("ATM"), designed to operate at a "total digital transfer rate" exceeding 1.5 Gbit/s;
   b. Equipment employing a "laser" and having any of the following:
      1. A transmission wavelength exceeding 1750 nm; **or**
      2. Employing analogue techniques and having a bandwidth exceeding 2.5 GHz;
      Note:
      1054.4.b.2. does not control "software" specially designed or modified for the "development" of commercial TV systems.
   c. Equipment employing "optical switching"; **or**
   d. Radio equipment employing quadrature-amplitude-modulation (QAM) techniques above level 128.

1055. Technology

1. "Technology" according to the General Technology Note for the "development", "production" or "use" (excluding operation) of equipment, functions or features, or "software" controlled by Category 1050.
2. Specific technologies, as follows:
   a. "Required" "technology" for the "development" or "production" of telecommunications equipment specially designed to be used on board satellites;
   b. "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;
   c. "Technology" for the "development" of digital cellular radio base station receiving equipment whose reception capabilities that allow multi-band, multi-channel, multi-mode, multi-coding algorithm or multi-protocol operation can be modified by changes in "software";
   d. "Technology" for the "development" of "spread spectrum" techniques, including "frequency hopping" techniques.
3. "Technology" according to the General Technology Note for the "development" or "production" of any of the following telecommunication transmission or "stored programme controlled" switching equipment, functions or features:
   a. Equipment employing digital techniques, including "Asynchronous Transfer Mode" ("ATM"), designed to operate at a "total digital transfer rate" exceeding 1.5 Gbit/s;
   b. Equipment employing a "laser" and having any of the following:
      1. A transmission wavelength exceeding 1750 nm;
      2. Performing "optical amplification" using praseodymium-doped fluoride fibre amplifiers (PDFFA);
      3. Employing coherent optical transmission or coherent optical detection techniques (also called optical heterodyne or homodyne techniques);
      4. Employing wavelength division multiplexing techniques exceeding 8 optical carriers in a single optical window; **or**
      5. Employing analogue techniques and having a bandwidth exceeding 2.5 GHz;
      Note:
      1055.3.b.5. does not control "technology" for the "development" or "production" of commercial TV systems.
   c. Equipment employing "optical switching";
   d. Radio equipment having any of the following:
      1. quadrature-amplitude-modulation (QAM) techniques above level 128 **or**
      2. Operating at input or output frequencies exceeding 31 GHz;
      Note
      1055.3.d.2. does not control "technology" for the "development" or "production" of equipment designed or modified for operation in any frequency band which is "allocated by the ITU" for radio-communications services, but not for radio-determination.
   e. Equipment employing "common channel signalling" operating in either non-associated or quasi- associated mode of operation.

Category 1150: Information Security

Note 1:
The control status of "information security" equipment, "software", systems, application specific "electronic assemblies", modules, integrated circuits, components or functions is determined in this Category even if they are components or "electronic assemblies" of other equipment.

Note 2:
Category 1150 does not control products when accompanying their user for the user's personal use.

Note 3:
Cryptography Note
1151. and 1154. do not control items that meet all of the following:

a. Generally available to the public by being sold, without restriction, from stock at retail selling points by means of any of the following:
   1. Over-the-counter transactions;
   2. Mail order transactions;
   *3. Electronic transactions; **or***
   4. Telephone call transactions;
b. The cryptographic functionality cannot easily be changed by the user;
*c. Designed for installation by the user without further substantial support by the supplier; **and***
d. When necessary, details of the items are accessible and will be provided, upon request, to the appropriate authority in the exporter's country in order to ascertain compliance with conditions described in paragraphs a. to c. above.
   N.B.:
   The 'appropriate authority' means an officer of the Export Controls Division of the Department of Foreign Affairs and International Trade.

Technical Note:
In Category 1150., parity bits are not included in the key length.

1151. Systems, Equipment and Components

1. Systems, equipment, application specific "electronic assemblies", modules or integrated circuits for "information security", as follows, and other specially designed components therefore:
   N.B.:
   For the control of global navigation satellite systems receiving equipment containing or employing decryption (i.e., GPS or GLONASS), see 1071.5.

   a. Designed or modified to use "cryptography" employing digital techniques performing any cryptographic function other than authentication or digital signature having any of the following:
      Technical Notes:
      1. Authentication and digital signature functions include their associated key management function.
      2. Authentication includes all aspects of access control where there is no encryption of files or text except as directly related to the protection of passwords, Personal Identification Numbers (PINs) or similar data to prevent unauthorised access.
      3. "Cryptography" does not include "fixed" data compression or coding techniques.
      Note:
      1151.1.a. includes equipment designed or modified to use "cryptography" employing analogue principles when implemented with digital techniques.

      1. A "symmetric algorithm" employing a key length in excess of 56 bits; **or**
      2. An "asymmetric algorithm" where the security of the algorithm is based on any of the following:
         a. Factorization of integers in excess of 512 bits (e.g., RSA);
         b. Computation of discrete logarithms in a multiplicative group of a finite field of size greater than 512 bits (e.g., Diffie-Hellman over Z/pZ); **or**
         c. Discrete logarithms in a group other than mentioned in 1151.1.a.2.b. in excess of 112 bits (e.g., Diffie-Hellman over an elliptic curve);

   b. Designed or modified to perform cryptanalytic functions;
   c. Deleted;
   d. Specially designed or modified to reduce the compromising emanations of information-bearing signals beyond what is necessary for health, safety or electromagnetic interference standards;
   e. Designed or modified to use cryptographic techniques to generate the spreading code for "spread spectrum" systems, including the hopping code for "frequency hopping" systems;
   f. Designed or modified to use cryptographic techniques to generate channelizing or scrambling codes for "time-modulated ultra-wideband" systems;
   g. 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;
   h. Communications cable systems designed or modified using mechanical, electrical or electronic means to detect surreptitious intrusion.

   Note:
   1151. does not control:
   a. "Personalised smart cards" where the cryptographic capability is restricted for use in equipment or systems excluded from control under entries b. to f. of this Note. If a "personalised smart card" has multiple functions, the control status of each function is assessed individually.
   b. Receiving equipment for radio broadcast, pay television or similar restricted audience broadcast of the consumer type, without digital encryption except that exclusively used for sending the billing or programme-related information back to the broadcast providers;
   c. Equipment where the cryptographic capability is not user-accessible and which is specially designed and limited to allow any of the following:
      1. Execution of copy-protected software;
      2. Access to any of the following:
         a. Copy-protected contents stored on read-only media; or
         *b. Information stored in encrypted form on media (e.g. in connection with the protection of intellectual property rights) when the media is offered for sale in identical sets to the public; **or***
      3. One-time copying of copyright protected audio/video data.
   d. Cryptographic equipment specially designed and limited for banking use or money transactions;
      Technical Note:
      'Money transactions' in 1151. Note d. includes the collection and settlement of fares or credit functions.
   e. Portable or mobile radiotelephones for civil use (e.g., for use with commercial civil cellular radiocommunications systems) that are not capable of end-to-end encryption;
   f. Cordless telephone equipment not capable of end-to-end encryption where the maximum effective range of unboosted cordless operation (i.e., a single, unrelayed hop between terminal and home basestation) is less than 400 metres according to the manufacturer's specifications.

1152. Test, Inspection and Production Equipment

1. Equipment specially designed for:
   a. The "development" of equipment or functions controlled by Category 1150, including measuring or test equipment;
   b. The "production" of equipment or functions controlled by Category 1150, including measuring, test, repair or production equipment.

1152. con't.

2. Measuring equipment specially designed to evaluate and validate the "information security" functions controlled by 1151. or 1154.

1153. Materials

None.

1154. Software

1. "Software" specially designed or modified for the "development", "production" or "use" of equipment or "software" controlled by Category 1150.
2. "Software" specially designed or modified to support "technology" controlled by 1155.
3. Specific "software" as follows:
   a. "Software" having the characteristics, or performing or simulating the functions of the equipment controlled by 1151. or 1152.;
   b. "Software" to certify "software" controlled by 1154.3.a.

Note:

1154. does not control:

a. "Software" required for the "use" of equipment excluded from control under the Note to 1151.;

b. "Software" providing any of the functions of equipment excluded from control under the Note to 1151.

1155. Technology

1. "Technology" according to the General Technology Note for the "development", "production" or "use" of equipment or "software" controlled by Category 1150.

Category 1060: Sensors and Lasers

1061. Equipment, Assemblies and Components

1. Acoustics

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

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

Note:

1061.1.a.1. does not control:

a. Depth sounders operating vertically below the apparatus, not including a scanning function exceeding ± 20°, and limited to measuring the depth of water, the distance of submerged or buried objects or fish finding;

b. Acoustic beacons, as follows:

1. Acoustic emergency beacons;

2. Pingers specially designed for relocating or returning to an underwater position.

a. Wide-swath bathymetric survey systems designed for sea bed topographic mapping, having all of the following:

1. Being designed to take measurements at an angle exceeding 20° from the vertical;

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

3. Being designed to provide any of the following:

a. Incorporation of multiple beams any of which is less than 1.9°; **or**

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

1. a. 1. 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 μPa 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 μPa 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° on any axis and having an operating frequency of less than 100 kHz;
5. Designed to operate with an unambiguous display range exceeding 5,120 m; **or**
6. Designed to withstand pressure during normal operation at depths exceeding 1,000 m and having transducers with any of the following:
   a. Dynamic compensation for pressure; **or**
   b. Incorporating other than lead zirconate titanate as the transduction element;

1. a. 1. c. Acoustic projectors, including transducers, incorporating piezoelectric, magnetostrictive, electrostrictive, electrodynamic or hydraulic elements operating individually or in a designed combination, having any of the following:

Notes:

1. The control status of acoustic projectors, including transducers, specially designed for other equipment is determined by the control status of the other equipment.

2. 1061.1.a.1.c. does not control electronic sources which direct the sound vertically only, or mechanical (e.g., air gun or vapour-shock gun) or chemical (e.g., explosive) sources.

1. An instantaneous radiated acoustic power density exceeding 0.01 mW/mm^2/Hz for devices operating at frequencies below 10 kHz;
2. A continuously radiated acoustic power density exceeding 0.001 mW/mm^2/Hz for devices operating at frequencies below 10 kHz; **or**

Technical Note:

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

3. Side-lobe suppression exceeding 22 dB;

1. a. 1. d. Acoustic systems, equipment and specially designed components for determining the position of surface vessels or underwater vehicles designed to operate at a range exceeding 1,000 m with a positioning accuracy of less than 10 m rms (root mean square) when measured at a range of 1,000 m;

Note:

1061.1.a.1.d includes:

a. Equipment using coherent "signal processing" between two or more beacons and the hydrophone unit carried by the surface vessel or underwater vehicle;

1061.1.a.1.d. notes con't

b. Equipment capable of automatically correcting speed-of-sound propagation errors for calculation of a point.

1. a. 2. Passive (receiving, whether or not related in normal application to separate active equipment) systems, equipment and specially designed components therefore, as follows:
   a. Hydrophones having any of the following characteristics:
   Note:
   The control status of hydrophones specially designed for other equipment is determined by the control status of the other equipment
      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 exceeding 35 m, with acceleration compensation; **or**
      5. Designed for operation at depths exceeding 1,000 m;

      Technical Note:
      Hydrophone sensitivity is defined as twenty times the logarithm to the base 10 of the ratio of rms output voltage to a 1 V rms reference, when the hydrophone sensor, without a pre-amplifier, is placed in a plane wave acoustic field with an rms pressure of 1 μPa. For example, a hydrophone of -160 dB (reference 1 V per μPa) would yield an output voltage of 10^{-8} V in such a field, while one of -180 dB sensitivity would yield only 10^{-9} V output. Thus, -160 dB is better than -180 dB.

1. a. 2. b. Towed acoustic hydrophone arrays having any of the following:
   1. Hydrophone group spacing of less than 12.5 m;
   2. 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. Heading sensors controlled by 1061.1.a.2.d.;
   4. Longitudinally reinforced array hoses;
   5. An assembled array of less than 40 mm in diameter;
   6. Multiplexed hydrophone group signals designed to operate at depths exceeding 35 m or having an adjustable or removable depth sensing device in order to operate at depths exceeding 35 m; **or**
   7. Hydrophone characteristics specified in 1061.1.a.2.a.;

1. a. 2. c. Processing equipment, specially designed for towed acoustic hydrophone arrays, having "user accessible programmability" and time or frequency domain processing and correlation, including spectral analysis, digital filtering and beamforming using Fast Fourier or other transforms or processes;

1. a. 2. d. Heading sensors having all of the following:
   1. An accuracy of better than ± 0.5°; **and**
   2. Designed to operate at depths exceeding 35 m or having an adjustable or removable depth sensing device in order to operate at depths exceeding 35 m;

1. a 2. e. Bottom or bay cable systems having any of the following:
   1. Incorporating hydrophones specified in 1061.1.a.2.a.; **or**;
   2. Incorporating multiplexed hydrophone group signal modules having all of the following characteristics:
      a. Designed to operate at depths exceeding 35 m or having an adjustable or removable depth sensing device in order to operate at depths exceeding 35 m; **and**
      b. Capable of being operationally interchanged with towed acoustic hydrophone array modules;

1. a. 2. f. Processing equipment, specially designed for bottom or bay cable systems, having "user accessible program mability" and time or frequency domain processing and correlation, including spectral analysis, digital filtering and beamforming using Fast Fourier or other transforms or processes;

1. b. Correlation-velocity sonar log equipment designed to measure the horizontal speed of the equipment carrier relative to the sea bed at distances between the carrier and the sea bed exceeding 500 m.

2. Optical Sensors

a. Optical detectors, as follows:
Note:
1061.2.a. does not control germanium or silicon photodevices.

   1. "Space-qualified" solid-state detectors, as follows:
      a. "Space-qualified" solid-state detectors, having all of the following:
         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. "Space-qualified" solid state detectors, having all of the following:
         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;
      c. "Space-qualified" solid state detectors having a peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm;

2. a. 2. Image intensifier tubes and specially designed components therefore, 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 15 μm or less; **and**
      3. Photocathodes, as follows:

1061.2.a.2.a. con't.

a. S-20, S-25 or multialkali photocathodes with a luminous sensitivity exceeding 240 μA/lm;
b. GaAs or GaInAs photocathodes;
c. Other III-V compound semiconductor photocathodes;
Note:
1061.2.a.2.a.3.c. does not control compound semiconductor photocathodes with a maximum radiant sensitivity of 10 mA/W or less.

b. Specially designed components, as follows:
1. Microchannel plates having a hole pitch (centre-to-centre spacing) of 15 μm or less;
2. GaAs or GaInAs photocathodes;
3. Other III-V compound semiconductor photocathodes;
Note:
1061.2.a.2.b.3. does not control compound semiconductor photocathodes with a maximum radiant sensitivity of 10 mA/W or less.

2. a. 3. Non-"space-qualified" "focal plane arrays", as follows:
Technical Note:
Linear or two-dimensional multi-element detector arrays are referred to as "focal plane arrays".
Notes:
1. 1061.2.a.3. includes photoconductive arrays and photovoltaic arrays.
2. 1061.2.a.3. does not control:
a. Silicon "focal plane arrays";
b. Multi-element (not to exceed 16 elements) encapsulated photo-conductive cells using either lead sulphide or lead selenide;
c. Pyrolelctric detectors using anyof the following:
1. Triglycine sulphate and variants:
2. Lead-lanthanum-zirconium titanate and variants:
3. Lithiuim tantalate:
*4. Polyvinylidene fluoride and variants; **or***
5. Strontium barium niobate and variants

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

2. b. "Monospectral imaging sensors" and "Multispectral imaging sensors" designed for remote sensing applications, having any of the following:
1. An Instantaneous-Field-Of-View (IFOV) of less than 200 μr (microradians); **or**
2. Being specified for operation in the wavelength range exceeding 400 nm but not exceeding 30,000 nm and having all of the following:
a. Providing output imaging data in digital format; **and**
b. Being any of the following:
1. "Space-qualified"; **or**
2. Designed for airborne operation, using other than silicon detectors, and having an IFOV of less than 2.5 mr (milliradians).

c. Direct view imaging equipment operating in the visible or infrared spectrum, incorporating any of the following:
1. Image intensifier tubes having the characteristics listed in 1061.2.a.2.a.; **or**
2. "Focal plane arrays" having the characteristics listed in 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 control the following equipment incorporating other than GaAs or GaInAs photocathodes:
a. Industrial or civilian intrusion alarm, traffic or industrial movement control or counting systems;
b. Medical equipment;
c. industrial equipment used for inspection, sorting or analysis of the properties of materials;
d. Flame detectors for industrial furnaces;
e. Equipment specially designed for laboratory use.

d. Special support components for optical sensors, as follows:
1. "Space-qualified" cryocoolers;
2. Non-"space-qualified" cryocoolers, having 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 mini-coolers having bore (outside) diameters of less than 8 mm;
3. Optical sensing fibres specially fabricated either compositionally or structurally, or modified by coating, to be acoustically, thermally, inertially, electromagnetically or nuclear radiation sensitive.

e. "Space qualified" "focal plane arrays" having more than 2,048 elements per array and having a peak response in the wavelength range exceeding 300 nm but not exceeding 900 nm.

3. Cameras

N.B.:
For cameras specially designed or modified for underwater use, see 1081.2.d. and 1081.2.e.

a. Instrumentation cameras and specially designed components therefore, as follows:
Note:
Instrumentation cameras, controlled by 1061.3.a.3. to 1061.3.a.5., with modular structures should be evaluated by their maximum capability, using plug-ins available according to the camera manufacturer's specifications.

1. High-speed cinema recording cameras using any film format from 8 mm to 16 mm inclusive, in which the film is continuously advanced throughout the recording period, and that are capable of recording at framing rates exceeding 13,150 frames/s;
Note:
1061.3.a.1. does not control cinema recording cameras designed for civil purposes.

1061.3.a. con't.

2. Mechanical high speed cameras, in which the film does not move, capable of recording at rates exceeding 1,000,000 frames/s for the full framing height of 35 mm film, or at proportionately higher rates for lesser frame heights, or at proportionately lower rates for greater frame heights;
3. Mechanical or electronic streak cameras having writing speeds exceeding 10 mm/μs;
4. Electronic framing cameras having a speed exceeding 1,000,000 frames/s;
5. Electronic cameras having all of the following:
   a. An electronic shutter speed (gating capability) of less than 1 μs per full frame; and
   b. A read out time allowing a framing rate of more than 125 full frames per second.
6. Plug-ins, having all of the following characteristics:
   a. Specially designed for instrumentation cameras which have modular structures and which are controlled by 6.A.3.a.; **and**
   b. Enabling these cameras to meet the characteristics specified in 6.A.3.a.3., 6.A.3.a.4. or 6.A.3.a.5., according to the manufacturer's specifications.

b. Imaging cameras, as follows:

Note:
1061.3.b. does not control 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 x 10^6 "active pixels" per solid state array for monochrome (black and white) cameras;
   b. More than 4 x 10^6 "active pixels" per solid state array for colour cameras incorporating three solid state arrays; **or**
   c. More than 12 x 10^6 "active pixels" for solid state array colour cameras incorporating one solid state array;

   Technical Note
   For the purpose of this entry, digital video cameras should be evaluated by the maximum number of "active pixels" used for capturing moving images.

2. Scanning cameras and scanning camera systems, having all of the following:
   a. Linear detector arrays with more than 8,192 elements per array; **and**
   b. Mechanical scanning in one direction;
3. Imaging cameras incorporating image intensifier tubes having the characteristics listed in 1061.2.a.2.a.;
4. Imaging cameras incorporating "focal plane arrays" having the characteristics listed in 1061.2.a.3.

   Note:
   1061.3.b.4. does not control imaging cameras incorporating linear "focal plane arrays" with twelve elements or fewer, not employing time-delay-and-integration within the element, designed for any of the following:
   a. Industrial or civilian intrusion alarm, traffic or industrial movement control or counting systems;
   b. Industrial equipment used for inspection or monitoring of heat flows in buildings, equipment or industrial processes;
   c. Industrial equipment used for inspection, sorting or analysis of the properties of materials;
   d. Equipment specially designed for laboratory use; or
   e. Medical equipment.

4. Optics

a. Optical mirrors (reflectors), as follows:
   1. "Deformable mirrors" having either continuous or multi-element surfaces, and specially designed components therefore, capable of dynamically repositioning portions of the surface of the mirror at rates exceeding 100 Hz;
   2. Lightweight monolithic mirrors having an average "equivalent density" of less than 30 kg/m^2 and a total mass exceeding 10 kg;
   3. Lightweight "composite" or foam mirror structures having an average "equivalent density" of less than 30 kg/m^2 and a total mass exceeding 2 kg;
   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) having a control bandwidth exceeding 100 Hz.

b. Optical components made from zinc selenide (ZnSe) or zinc sulphide (ZnS) with transmission in the wavelength range exceeding 3,000 nm but not exceeding 25,000 nm and having any of the following:
   1. Exceeding 100 cm^3 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. Raw substrates, processed substrates having surface coatings (single-layer or multi-layer, metallic or dielectric, conducting, semiconducting or insulating) or having 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 m in diameter;
   4. Manufactured from "composite" materials having a coefficient of linear thermal expansion equal to or less than 5 x 10^{-6} in any coordinate direction.

d. Optical control equipment, as follows:
   1. Specially designed to maintain the surface figure or orientation of the "space-qualified" components controlled by 1061.4.c.1. or 1061.4.c.3.;
   2. Having steering, tracking, stabilization or resonator alignment bandwidths equal to or more than 100 Hz and an accuracy of 10 μr (microradians) or less;
   3. Gimbals having all of the following:
      a. a maximum slew exceeding 5°;
      b. a bandwidth of 100 Hz or more;
      c. Angular pointing errors of 200 μr (microradians) or less; **and**
      d. Having any of the following:
         1. Exceeding 0.15 m but not exceeding 1 m in diameter or major axis length and capable of angular accelerations exceeding 2 r(radians)/s^2; **or**
         2. Exceeding 1 m in diameter or major axis length and capable of angular accelerations exceeding 0.5 r(radians)/s^2;
   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;

1061.4. con't.

e. Aspheric optical elements having all of the following characteristics:
   1. The largest dimension of the optical-aperture is greater than 400 mm;
   2. The surface roughness is less than 1 nm (rms) for sampling lengths equal to or greater than 1 mm; **and**
   3. The coefficient of linear thermal expansion's absolute magnitude is less than 3×10^{-6}/K at 25° C;

Technical Notes.

1. An 'aspheric optical element' is any element used in an optical system whose imaging surface or surfaces are designed to depart from the shape of an ideal sphere.

2. Manufacturers are not required to measure the surface roughness listed in 6.A.4.e.2. unless the optical element was designed or manufactured with the intent to meet, or exceed, the control parameter.

Note.

1061.a.4.e. does not control aspheric optical elements having any of the following:

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

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

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

d. Being fabricated from borosilicate glass having a coefficient of linear themal expansion greater than 2.5×10^{-6}K at 25° C; or

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

N.B.

For aspheric optical elements specially designed for lithography equipment, see Item 1061.a.3.b.1.

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 control 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.

a. Gas "lasers", as follows:
   1. Excimer "lasers" having any of the following:
      a. An output wavelength not exceeding 150 nm and having any of the following:
         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 having any of the following:
         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 having any of the following:
         1. An output energy exceeding 10 J per pulse; **or**
         2. An average output power exceeding 500 W; **or**
      d. An output wavelength exceeding 360 nm and having any of the following:
         1. An output energy exceeding 1.5 J per pulse; or
         2. An average output power exceeding 30 W;

N.B.:

For excimer "lasers" specially designed for lithography equipment, see 1032.1.

5. a. 2. Metal vapour "lasers", as follows:
      a. Copper (Cu) "lasers" having an average output power exceeding 20 W;
      b. Gold (Au) "lasers" having an average output power exceeding 5 W;
      c. Sodium (Na) "lasers" having an output power exceeding 5 W;
      d. Barium (Ba) "lasers" having an average output power exceeding 2 W;
   3. Carbon monoxide (CO) "lasers" having any of the following:
      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 (CO2) "lasers" having any of the following:
      a. A CW output power exceeding 15 kW;
      b. A pulsed output having a "pulse duration" exceeding 10 μs and having any of the following:
         1. An average output power exceeding 10 kW; **or**
         2. A pulsed "peak power" exceeding 100 kW; **or**
      c. A pulsed output having a "pulse duration" equal to or less than 10 μs and having any of the following:
         1. A pulse energy exceeding 5 J per pulse ; **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", as follows:
         1. Oxygen Iodine (O_2-I) "lasers";
         2. Deuterium Fluoride-Carbon dioxide (DF-CO2) "lasers";
   6. Krypton ion or argon ion "lasers", having any of the following:
      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", having any of the following:

Note:

1061.5.a.7. does not control nitrogen "lasers".

      a. An output wavelength not exceeding 150 nm and having any of the following:
         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 having any of the following:
         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 having any of the following:
         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.

5. b. Semiconductor "lasers", as follows:
   1. Individual single-transverse mode semiconductor "lasers", having any of the following;

1061.5.b.1. con't.

a. A wavelength equal to or less than 1510 nm, and having an average or CW output power exceeding 1.5 W; **or**
b. A wavelength greater than 1510 nm, and having an average or CW output power exceeding 500 mW

2. Individual, multiple-transverse mode semiconductor "lasers", having all of the following:
   a. A wavelength of less than 950 nm, or more than 2000 nm; **and**
   b. An average or CW output power exceeding 10 W;
3. Individual arrays of semiconductor "lasers", having any of the following:
   a. A wavelength of less than 950 nm, and having an average or CW output power exceeding 60 W; **or**
   b. A wavelength equal to or greater than 2000 nm, and having an average or CW output power exceeding 10 W;

Technical Note:
Semiconductor "lasers" are commonly called "laser" diodes.
Note 1:
1061.5.b. includes semi-conductor "lasers" having optical output connectors (e.g. fibre optic pigtails).
Note 2:
The control status of semi-conductor "lasers" specially designed for other equipment is determined by the control status of the other equipment.

c. Solid state "lasers", as follows:
   1. "Tunable" "lasers" having any of the following:

Note:
1061.5.c.1. includes titanium - sapphire(T_i: Al_2O_3), thulium - YAG (Tm: YAG), thulium - YSGG (Tm: YSGG), alexandrite (Cr: $BeAl_2O_4$) and colour centre "lasers".

      a. An output wavelength less than 600 nm and having any of the following:
         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 having any of the following:
         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 having any of the following:
         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. Neodymium glass "lasers", as follows:
         1. "Q-switched lasers" having any of the following:
            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 any of the following:
            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.
      b. Neodymium-doped (other than glass) "lasers", having an output wavelength exceeding 1,000 nm but not exceeding 1,100 nm, as follows:

N.B.:
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.c).

         1. Pulse-excited, mode-locked, "Q-switched lasers" having a "pulse duration" of less than 1 ns and having any of the following:
            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" having a pulse duration equal to or more than 1 ns, and having any of the following:
            a. A single-transverse mode output having:
               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 having:
               1. A "peak power" exceeding 400 MW;
               2. An average output power exceeding 2 kW; **or**
               3. A pulsed energy exceeding 2 J;

5. c. 2. b. 3. Pulse-excited, non-"Q-switched lasers",having:
   a. A single-transverse mode output having:
      1. A "peak power" exceeding 500 kW; or
      2. An average output power exceeding 150 W; **or**
   b. A multiple-transverse mode output having:
      1. A "peak power" exceeding 1 MW; **or**
      2. An average power exceeding 2 kW;
4. Continuously excited "lasers" having:
   a. A single-transverse mode output having:
      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 having:
      1. A "peak power" exceeding 1 MW; **or**
      2. An average or CW output power exceeding 2 kW;

5. c. 2. c. Other non-"tunable" "lasers", having any of the following:
   1. A wavelength less than 150 nm and having any of the following:
      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 having any of the following:
      a. An output energy exceeding 1.5 J per pulse and a pulsed "peak power" exceeding 30 W; **or**

1061.5.c.2.c.2. con't.

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" having:
      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-tranverse mode "lasers";
         b. 30 W for multiple-transverse mode "lasers";
   b. Non-"Q-switched lasers" having:
      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 having any of the following:
   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;

5. 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 having any of the following:
      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 having 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 having any of the following:
      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 having any of the following;
      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. 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.

      2. Optical mirrors or transmissive or partially transmissive optical or electro-optical components specially designed for use with controlled "lasers";
   f. Optical equipment, as follows:

N.B.:

For shared aperture optical elements, capable of operating in "Super-High Power Laser" ("SHPL") applications, see Item 2019., Note 2.d. on the Munitions List.

1. Dynamic wavefront (phase) measuring equipment capable of mapping at least 50 positions on a beam wavefront having any of the following:
   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 μr (microradians);
3. Optical equipment and 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 μm, 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 therefore, as follows:

Note:

1061.6. does not control instruments specially designed for biomagnetic measurements for medical diagnostics.

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 any of the following:
   1. 0.05 nT rms per square root Hz at frequencies of less than 1 Hz;
   2. 1×10^{-3} nT rms per square root Hz at frequencies of 1 Hz or more but not exceeding 10 Hz; **or**
   3. 1×10^{-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" controlled by 1061.6.a., 1061.6.b. or 1061.6.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 and having all of the following:

1061.6.h.1. con't.

1. Being 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. Being 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 μm and with associated input and output coupling circuits;
   b. Designed to operate with a magnetic field slew rate exceeding 1 x 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:

7. a. Gravity meters designed or modified for ground use having a static accuracy of less (better) than 10 μgal;

Note:

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

b. Gravity meters designed for mobile platforms having all of the following:
   1. A static accuracy of less (better) than 0.7 mgal; **and**
   2. An in-service (operational) accuracy of less (better) than 0.7 mgal having a time-to- steady-state registration of less than 2 minutes under any combination of attendant corrective compensations and motional influences;

c. Gravity gradiometers.

8. Radar

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

Note:

1061.8. does not control:

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.

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 ± 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) radar mode 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 control precision approach radar (PAR) equipment conforming to ICAO standards.

g. Specially designed for airborne (balloon or airframe mounted) operation and having Doppler signal processing for the detection of moving targets;
h. Employing processing of radar signals using any of the following:
   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 control:

a. Fishing ground surveillance radar;
b. Ground radar equipment specially designed for enroute air traffic control, provided that all the following conditions are met:
   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.
c. Weather balloon tracking radars.

j. Being "laser" radar or Light Detection and Ranging (LIDAR) equipment, having any 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 μr (microradians);

Note:

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

k. Having signal processing sub-systems using "pulse compression", with any of the following:
   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 any of the following:
   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 control 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 control 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
   Optical equipment, as follows:
   a. Equipment for measuring absolute reflectance to an accuracy of ± 0.1% of the reflectance value;
   b. Equipment other than optical surface scattering measurement equipment, having an unobscured aperture of more than 10 cm, specially designed for the non-contact optical measurement of a non-planar optical surface figure (profile) to an "accuracy" of 2 nm or less (better) against the required profile.
   Note:
   1062.4. does not control microscopes.
5. Lasers- None.
6. Magnetometers - None.
7. Gravimeters
   Equipment to produce, align and calibrate land-based gravity meters with a static accuracy of better than 0.1 mgal.
8. Radar
   Pulse radar cross-section measurement systems having transmit pulse widths of 100 ns or less and specially designed components therefore.

1063. Materials

1. Acoustics - None.
2. Optical Sensors
   Optical sensor materials, as follows:
   a. Elemental tellurium (Te) of purity levels of 99.9995% or more;
   b. Single crystals (including epitaxial wafers) of any of the following:
      1. cadmium zinc telluride (CdZnTe), with zinc content of less than 6% by mole fraction,
      2. cadmium telluride (CdTe) of any purity level; **or**
      3. mercury cadmium telluride (HgCdTe) of any purity level
      Technical Note
      Mole fraction is defined as the ratio of moles of ZnTe to the sum of the moles of CdTe and ZnTe present in the crystal.
3. Cameras - None.
4. Optics
   Optical materials, as follows:
4. a. Zinc selenide (ZnSe) and zinc sulphide (ZnS) "substrate blanks" produced by the chemical vapour deposition process, having any of the following:
      1. A volume greater than 100 cm^3; **or**
      2. A diameter greater than 80 mm having a thickness of 20 mm or more;
   b. Boules of the following electro-optic materials:
      1. Potassium titanyl arsenate (KTA);
      2. Silver gallium selenide ($AgGaSe_2$);
      3. Thallium arsenic selenide ($Tl_3A_sSe_3$, also known as TAS);
   c. Non-linear optical materials having all of the following:
      1. Third order susceptibility (chi 3) of 10^{-6} m^2/V^2 or more; **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. Glass, including fused silica, phosphate glass, fluorophosphate glass, zirconium fluoride (ZrF_4) and hafnium fluoride (HfF_4), having all of the following:
      1. A hydroxyl ion (OH-) 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 5×10^{-6};
   f. Synthetically produced diamond material with an absorption of less than 10^{-5} cm^{-1} for wavelengths exceeding 200 nm but not exceeding 14,000 nm.
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 controlled by 1061.4, 1061.5., 1061.8. or 1062.8.
2. "Software" specially designed for the "use" of equipment controlled by 1061.2.b., 1061.8. or 1062.8.
3. Other "software", as follows:
   a. Acoustics
   " Software", as follows:
      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;
      3. "Software" specially designed for acoustic beam forming for the "real time processing" of acoustic data for passive reception using bottom or bay cable systems;
      4. "Source code" for the "real time processing" of acoustic data for passive reception using bottom or bay cable systems;
   b. Optical Sensors - None;
   c. Cameras - None;
   d. Optics - None;
   e. Lasers - None;
   f. Magnetometers
      "Software", as follows:
      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;
   g. Gravimeters
      "Software" specially designed to correct motional influences of gravity meters or gravity gradiometers;
   h. Radar
      "Software", as follows:

1064.3. con't.

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"; **or**
   b. Accepting radar target data from more than four primary radars;
2. "Software" for the design or "production" of radomes which:
   a. Are specially designed to protect the "electronically steerable phased array antennae" controlled by 1061.8.e.; **and**
   b. Result in an antenna pattern having an average side lobe level more than 40 dB below the peak of the main beam level.
   Technical Note:
   'Average side lobe level' in 1064.3.h.2.b. is measured over the entire array excluding the angular extent of the main beam and the first two side lobes on either side of the main beam.

1065. Technology

1. "Technology" according to the General Technology Note for the "development" of equipment, materials or "software" controlled by 1061., 1062., 1063. or 1064.
2. "Technology" according to the General Technology Note for the "production" of equipment or materials controlled by 1061., 1062. or 1063.
3. Other "technology", as follows:
   a. Acoustics - None;
   b. Optical Sensors - None;
   c. Cameras - None;
   d. Optics
   "Technology", as follows:
      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 5×10^{-3};
      N.B.:
      See also 1025.3.f.
      2. Optical fabrication "technology" using single point diamond turning techniques to produce surface finish accuracies of better than 10 nm rms on non-planar surfaces exceeding 0.5 m^2;
   e. Lasers
   "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 any of the following:
      1. A "noise level" of less than 0.05 nT rms per square root Hz at frequencies of less than 1 Hz; **or**
      2. A "noise level" of less than 1×10^{-3} nT rms per square root Hz at frequencies of 1 Hz or more;
   g. Gravimeters - None;
   h. Radar - None.

Category 1070: Navigation and Avionics

1071. Systems, Equipment and Components

N.B.1:
For automatic pilots for underwater vehicles, see Category 1080.; For radar, see Category 1060.
N.B.2:
For inertial navigation equipment for ships or submersibles, see Item 2009.e. on the Munitions List.

1. Linear accelerometers designed for use in inertial navigation or guidance systems and having any of the following characteristics, and specially designed components therefore:
   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; **or**
   c. Specified to function at linear acceleration levels exceeding 100 g.
   N.B. *For angular or rotational accelerometers, see 1071.2.*

2. Gyros, and angular or rotational accelerometers having any of the following characteristics, and specially designed components therefore:
   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 g to 100 g inclusive; **or**
   b. Specified to function at linear acceleration levels exceeding 100 g.
3. Inertial Navigation Systems (INS) and specially designed components, as follows:
   a. Inertial navigation systems (gimballed and strapdown) and inertial equipment designed for "aircraft", land vehicle or "spacecraft" for attitude, guidance or control having any of the following characteristics, and specially designed components therefore:
      1. Navigation error (free inertial) subsequent to normal alignment of 0.8 nautical mile per hour (nm/hr) (Circular Error Probable (CEP)) or less (better); **or**
      2. Specified to function at linear acceleration levels exceeding 10 g.
   b. Hybrid Inertial Navigation Systems embedded with Global Navigation Satellite System(s) (GNSS) or "Data-Based Referenced Navigation" ("DBRN") System(s) for attitude, guidance or control, subsequent to normal alignment, having an INS navigation position accuracy, after loss of GNSS or "DBRN" for a period of up to 4 minutes, of less (better) than 10 meters CEP.

1071.3.b. notes con't.

Note 1:

The parameters of 1071.3.a. and 1071.3.b. are applicable with any of the following environmental conditions:

1. *Input random vibration with an overall magnitude of 7.7 g rms in the first half hour and a total test duration of one and one half hour per axis in each of the three perpendicular axes, when the random vibration meets the following:*
   a. *A constant power spectral density (PSD) value of 0.04 g^2/Hz over a frequency interval of 15 to 1,000Hz; and*
   b. *The PSD attenuates with frequency from 0.04 g^2/Hz to 0.01 g^2/Hz over a frequency interval from 1,000 to 2,000 Hz; or*
2. *A roll and yaw rate of equal to or more than +2.62 radian/s (150 deg/s); or*
3. *According to national standards equivalent to 1. or 2. above.*

Note 2:

1071.3. does not control inertial navigation systems which are certified for use on "civil aircraft" by civil authorities of a participating state.

Note 3

7.A.3. does not control inertial navigation systems specially designed for civil automobiles RU:land mobile vehicles

Technical Notes

1 1071.3.b. refers to systems in which an INS and other independent navigation aids are built into a single unit (embedded) in order to achieve improved performance.

2. 'Circular Error Probable' ('CEP') - In a circular normal distribution, the radius of the circle containing 50 percent of the individual measurements being made, or the radius of the circle within which there is a 50 percent probability of being located.

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 navigation satellite systems (i.e., GPS or GLONASS) receiving equipment having any of the following characteristics, and specially designed components therefore:
   a. Employing decryption; **or**
   b. A null-steerable antenna.
6. Airborne altimeters operating at frequencies other than 4.2 to 4.4 GHz inclusive, having any of the following characteristics:
   a. "Power management"; or
   b. Using phase shift key modulation.
7. Direction finding equipment operating at frequencies above 30 MHz and having all of the following characteristics, and specially designed components therefore:
   a. "Instantaneous bandwidth" of 1 MHz or more;
   b. Parallel processing of more than 100 frequency channels; **and**
   c. Processing rate of more than 1,000 direction finding results per second and per frequency channel.

1072. Test, Inspection and Production Equipment

1. Test, calibration or alignment equipment specially designed for equipment controlled by 1071.

Note:

1072.1. does not control test, calibration or alignment 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. Maintenance Level II does not include the removal of controlled accelerometers or gyro sensors from the SRA.

2. Equipment, as follows, specially designed to characterise 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 controlled by 1071.

Note:

1072.3. includes:

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 controlled by 1071. or 1072.
2. "Source code" for the "use" of any inertial navigation equipment, including inertial equipment not controlled by 1071.3. or 1071.4, or Attitude and Heading Reference Systems (AHRS)

Note:

1074.2. does not control "source code" for the "use" of gimballed AHRS.

Technical Note:

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

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 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:
      1. Doppler radar velocity;
      2. Global navigation satellite systems (i.e., GPS or GLONASS) reference data; **or**
      3. Data from "Data-Based Referenced Navigation" ("DBRN") systems.
   c. "Source code" for integrated avionics or mission systems which combine sensor data and employ "expert systems";
   d. "Source code" for the "development" of any of the following:
      1. Digital flight management systems for "total control of flight";

1074.3.d. con't.

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; **or**
7. Raster-type head-up displays or three dimensional displays;

e. Computer-aided-design (CAD) "software" specially designed for the "development" of "active flight control systems", helicopter multi-axis fly-by-wire or fly-by-light controllers or helicopter "circulation controlled anti-torque or circulation-controlled direction control systems" whose "technology" is controlled in 1075.4.b., 1075.4.c.1. or 1075.4.c.2.

1075. Technology

1. "Technology" according to the General Technology Note for the "development" of equipment or "software" controlled by 1071., 1072. or 1074.
2. "Technology" according to the General Technology Note for the "production" of equipment controlled by 1071. or 1072.
3 "Technology" according to the General Technology Note for the repair, refurbishing or overhaul of equipment controlled by 1071.1. to 1071.4.

Note:
1075.3. does not control 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.
N.B.:
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 controlled by 1071.1. or 1071.2.;
      5. Electric actuators (i.e., electromechanical, electro-hydrostatic and integrated actuator package) specially designed for "primary flight control";
      6. "Flight control optical sensor array" specially designed for implementating "active flight control systems";
   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 control 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 "total control of flight";

      Note:
      1075.4.b.5. does not control:
      a. "Development" "technology" for integration of digital flight control, navigation and propulsion control data into a digital flight management system for "flight path optimization";
      b. "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 multisensor mission management systems employing "expert systems";

      N.B.:
      For "technology" for Full Authority Digital Engine Control ("FADEC"), see 1095.3.a.9.

4. 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.

Category 1080: Marine

1081. Systems, Equipment and Components

1. Submersible vehicles and surface vessels, as follows:

   N.B.:
   For the control 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.

   a. Manned, tethered submersible vehicles designed to operate at depths exceeding 1,000 m;
   b. Manned, untethered submersible vehicles having any of the following:
      1. Designed to operate autonomously and having a lifting capacity of all the following:
         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. Having all of the following:
         a. Designed to carry a crew of 4 or more;
         b. Designed to operate autonomously for 10 hours or more;

1081.1.b. con't.

c. Having a range of 25 nautical miles or more; **and**
d. Having a length of 21 m or less;

Technical Notes:

1. For the purposes of 1081.1.b., operate autonomously means fully submerged, without snorkel, all systems working and cruising at minimum speed at which the submersible can safely control its depth dynamically by using its depth planes only, with no need for a support vessel or support base on the surface, sea-bed or shore, and containing a propulsion system for submerged or surface use.

2. For the purposes of 1081.1.b., range means half the maximum distance a submersible vehicle can cover.

c. Unmanned, tethered submersible vehicles designed to operate at depths exceeding 1,000 m, having any of the following:
   1. Designed for self-propelled manoeuvre using propulsion motors or thrusters controlled by 1081.2.a.2.; **or**
   2. Having a fibre optic data link;
d. Unmanned, untethered submersible vehicles, having any of the following:
   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 any 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. Sea-floor navigation and navigation integration systems for depths exceeding 1,000 m with positioning accuracies to within 10 m of a pre-determined point;
f. Surface-effect vehicles (fully skirted variety) having all of the following characteristics:
   1. A maximum design speed, fully loaded, exceeding 30 knots in a significant wave height of 1.25 m (Sea State 3) or more;
   2. A cushion pressure exceeding 3,830 Pa; **and**
   3. 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 having any of the following:
   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 x (displaced volume at the operational design draft)$^{2/3}$.

2. Systems and equipment, as follows:

N.B.:

For underwater communications systems, see Category 1050 - Telecommunications.

a. Systems and 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 therefore, using optical fibre and having synthetic strength members;
b. Systems specially designed or modified for the automated control of the motion of submersible vehicles controlled by 1081.1. using navigation data and having closed loop servo-controls:
   1. Enabling a vehicle to move within 10 m of a predetermined point in the water column;
   2. Maintaining the position of the vehicle within 10 m of a predetermined point in the water column; **or**
   3. Maintaining 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. Television systems and television cameras, as follows:
      a. Television systems (comprising camera, monitoring and signal transmission equipment) having a limiting resolution when measured in air of more than 800 lines and specially designed or modified for remote operation with a submersible vehicle;
      b. Underwater television cameras having a limiting resolution when measured in air of more than 1,100 lines;
      c. Low light level television cameras specially designed or modified for underwater use containing all of the following:
         1. Image intensifier tubes controlled by 1061.2.a.2.a.; **and**
         2. More than 150,000 "active pixels" per solid state area array;

      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;
e. Photographic still cameras specially designed or modified for underwater use below 150m having a film format of 35 mm or larger, and having any of the following:
   1. Annotation of the film with data provided by a source external to the camera;
   2. Automatic back focal distance correction; **or**
   3. Automatic compensation control specially designed to permit an underwater camera housing to be usable at depths exceeding 1,000 m;

1081.2.h. con't.

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 and a flash rate of more than 5 flashes per second;
   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 controlled" computer, having any of the following:
   1. Systems that control the "robot" using information from sensors which measure force or torque applied to an external object, distance to an external object, or tactile sense between the "robot" and an external object; **or**
   2. The ability to exert a force of 250 N or more or a torque of 250 Nm or more and using titanium based alloys or "fibrous or filamentary" "composite" materials in their structural members;

i. Remotely controlled articulated manipulators specially designed or modified for use with submersible vehicles, having any of the following:
   1. 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**
   2. Controlled by proportional master-slave techniques or by using a dedicated "stored programme controlled" 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 controlled" computer are counted when determining the number of degrees of freedom of movement.

2. j. Air independent power systems, specially designed for underwater use, as follows:
   1. Brayton 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;
   4. Stirling cycle engine air independent power systems, having all 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; and
      b. Specially designed exhaust systems which discharge the products of combustion against a pressure of 100 kPa or more;

2. k. Skirts, seals and fingers, having any of the following:
   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) controlled by 1081.1.f.; **or**
   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) controlled by 1081.1.g.;

l. Lift fans rated at more than 400 kW specially designed for surface effect vehicles controlled by 1081.1.f. or 1081.1.g.;

m. Fully submerged subcavitating or supercavitating hydrofoils specially designed for vessels controlled by 1081.1.h.;

n. Active systems specially designed or modified to control automatically the sea-induced motion of vehicles or vessels controlled by 1081.1.f., 1081.1.g., 1081.1.h. or 1081.1.i.;

o. Propellers, power transmission systems, power generation systems and noise reduction systems, as follows:
   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 controlled by 1081.1.f., 1081.1.g., 1081.1.h. or 1081.1.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 tech-niques for smoothing the flow into a propeller;
      d. Light-weight, high capacity (K factor exceeding 300) reduction gearing;

1081.2.o. con't.

e. Power transmission shaft systems, incorporating "composite" material components, capable of transmitting more than 1 MW;

2. Water-screw propeller, power generation systems or transmission systems designed 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, incor-porating "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 designed for use on vessels of 1,000 tonnes displacement or more, as follows:
   a. Systems that attenuate underwater noise at frequencies below 500 Hz and consist of compound acoustic mounts for the acoustic isolation of diesel engines, diesel generator sets, gas turbines, gas turbine generator sets, propulsion motors or propulsion reduction gears, specially designed for sound or vibration isolation, 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 having 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.

q. Self-contained, closed or semi-closed circuit (rebreathing) diving and underwater swimming apparatus.
Note:
1081.2.q. does not control an individual apparatus for use when accompanying its user

1082. Test, Inspection and Production Equipment

1. Water tunnels, having a background noise of less than 100 dB (reference 1 μPa, 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

1. Syntactic foam designed for underwater use, having all of the following:
   a. Designed for marine depths exceeding 1,000 m; **and**
   b. A density less than 561 kg/m3.
   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 controlled 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 controlled 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 controlled by 1081.1., 1081.2.b., 1081.2.j., 1081.2.o. or 1081.2.p.

Category 1090: Propulsion

1091. Systems, Equipment and Components

N.B.:
For propulsion systems designed or rated against neutron or transient ionizing radiation, see Group 2, Munitions List.

1. Aero gas turbine engines incorporating any of the technologies controlled 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 number of up to 16 civil certified engines, assemblies or components including spares, is considered appropriate.
   b. Not certified for civil use by the aviation authorities in a participating state;
   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 not exceeding 0.219 kg/kWh in the power range from 35 to 100 %, and specially designed assemblies and components therefore.
   Note:
   The term 'marine gas turbine engines' includes those industrial, or aero-derivative, gas turbine engines adapted for a ship's electric power generation or propulsion.
3. Specially designed assemblies and components, incorporating any of the technologies controlled by 1095.3.a., for the following gas turbine engine propulsion systems:
   a. Controlled by 1091.1.; **or**
   b. Whose design or production origins are either non-participating states or unknown to the manufacturer.
4. Space launch vehicles and "spacecraft".

1091.4. con't.

Note:
1091.4. does not control payloads.
N.B.
For the control status of products contained in "spacecraft" payloads, see the appropriate Categories.

5. Liquid rocket propulsion systems containing any of the systems or components controlled by 1091.6.
6. Systems and components specially designed for liquid rocket propulsion systems, as follows:
   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 therefore;
   f. Propellant storage systems using the principle of capillary containment or positive expulsion (i.e., with flexible bladders);
   g. Liquid propellant injectors, with individual orifices of 0.381mm or smaller in diameter (an area of 1.14×10^{-3} cm^2 or smaller for non-circular orifices) specially designed for liquid rocket engines;
   h. One-piece carbon-carbon thrust chambers or one-piece carbon-carbon exit cones with densities exceeding $1.4 g/cm^3$ and tensile strengths exceeding 48 MPa.
7. Solid rocket propulsion systems with any of the following:
   a. Total impulse capacity exceeding 1.1 MNs;
   b. 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;
   c. Stage mass fractions exceeding 88% and propellant solid loadings exceeding 86%;
   d. Any of the components controlled by 1091.8.; **or**
   e. 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.
      Technical Note:
      For the purposes of 1091.7.e., a strong mechanical bond means bond strength equal to or more than propellant strength.
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;
      Technical Note:
      For the purposes of 1091.8.a., a strong mechanical bond means bond strength equal to or more than propellant strength.
   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 any of the following:
      1. Omni-axial movement exceeding ± 5°
      2. Angular vector rotations of 20°/s or more; or
      3. Angular vector accelerations of $40°/s^2$ or more.
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, systems and structures for launch vehicles, launch vehicle propulsion systems or "spacecraft", as follows:
   a. Components or structures exceeding 10kg, specially designed for launch vehicles manufactured using metal "matrix", "composite", organic "composite", ceramic "matrix" or intermetallic reinforced materials controlled by 1013.7. or 1013.10.;
      Note:
      The weight cut-off is not relevant for nose cones.
   b. Components and structures specially designed for launch vehicle propulsion systems controlled by 1091.5. to 1091.9. manufactured using metal matrix, composite, organic composite, ceramic matrix or intermetallic reinforced materials controlled by 1013.7. or 1013.10.;
   c. Structural components and isolation systems specially designed to control actively the dynamic response or distortion of "spacecraft" structures;
   d. Pulsed liquid rocket engines with thrust-to-weight ratios equal to or more than 1kN/kg and a response time (the time required to achieve 90% of total rated thrust from start-up) of less than 30 ms.
11. Ramjet, scramjet or combined cycle engines and specially designed components therefore.
12. Unmanned aerial vehicles having any of the following:
   a. An autonomous flight control and navigation capability (e.g. an autopilot with an Inertial Navigation System); **or**
   b. Capability of controlled-flight out of the direct vision range involving a human operator (e.g. televisual remote control).
   Note:
   1091,12, does not control model aircraft.
   N.B.:
   A model aircraft is intended for recreational and competition purposes.

1092. Test, Inspection and Production Equipment

1. Specially designed equipment, tooling and fixtures, as follows, for manufacturing or measuring gas turbine blades, vanes or tip shroud castings:
   a. Directional solidification or single crystal casting equipment;
   b. Ceramic cores or shells;
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 controlled by 1095.3.a.

1092. con't.

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 temperatures in excess of 773 K (500° C), and specially designed components or accessories therefore.
4. Tools, dies or fixtures for the solid state joining of "superalloy", titanium or intermetallic airfoil-to-disk com-binations described in 1095.3.a.3. or 1095.3.a.6. for gas turbines.
5. On-line (real time) control systems, instrumentation (including sensors) or automated data acquisition and processing equipment, specially designed for use with any of the following 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; **or**
   c. Wind tunnels or devices, other than two-dimensional sections, capable of simulating Reynolds number flows exceeding 25 x 10^6.
6. Acoustic vibration test equipment capable of producing sound pressure levels of 160 dB or more (referenced to 20 μPa) with a rated output of 4 kW or more at a test cell temperature exceeding 1,273 K (1,000°C), and specially designed quartz heaters therefore.
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.
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" specially designed or modified for the "development" of equipment or "technology" controlled by 1091., 1092. or 1095.3.
2. "Software" specially designed or modified for the "production" of equipment controlled by 1091. or 1092.
3. "Software" specially designed or modified for the "use" of full authority digital electronic engine controls ("FADEC") for propulsion systems controlled by 1091. or equipment controlled 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. 2D or 3D viscous "software" validated with wind tunnel or flight test data required for detailed engine flow modeling;
   b. "Software" for testing aero gas turbine engines, assemblies or components, specially designed to collect, reduce and analyze 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;
   c. "Software" specially designed to control directional solidification or single crystal casting;
   d. "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.d. does not control "software" embedded in uncontrolled 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" controlled 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 controlled by 1091.1.c., 1091.4. to 1091.11. or 1092.
   N.B.:
   For "technology" for the repair of controlled structures, laminates or materials, see 1015.2.f.
   Note.
   "Development" or "production" "technology" controlled by 1095. for gas turbine engines remains controlled when used as "use" "technology" for repair, rebuild and overhaul. Excluded from control 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.
3. Other "technology", as follows:
   a. "Technology" "required" for the "development" or "production" of any 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 1,813 K (1,540°C), or combustors incorporating thermally decoupled combustion liners, non-metallic liners or non-metallic shells;
      3. Components manufactured from any of the following:
         a. organic "composite" materials designed to operate above 588 K (315°C);
         b. metal "matrix" "composite", ceramic "matrix", intermetallic or intermetallic reinforced materials controlled by 1013.7; **or**
         c. "composite" material controlled by 1013.10. and manufactured with resins controlled by 1013.8.

1095.3.a. con't.

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" controlled by 1025.3.b.;
8. Damage tolerant gas turbine engine rotating components using powder metallurgy materials controlled 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; **or**
    c) Propelling nozzles;

    Notes:

    1. Adjustable flow path geometry and associated control systems in 1095.3.a.10. do not include inlet guide vanes, variable pitch fans, variable stators or bleed valves for compressors.

    2. 1095.3.a.10. does not control "development" or "production" "technology" for adjustable flow path geometry for reverse thrust.

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

b. "Technology" "required" for the "development" or "production" of any of the following:
   1. Wind tunnel aero-models equipped with non-intrusive sensors capable of transmitting data from the sensors to the data acquisition system; **or**
   2. "Composite" propeller blades or propfans capable of absorbing more than 2,000 kW at flight speeds exceeding Mach 0.55;

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

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

   Technical Note:

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

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

   Width: The widest of the following:
   - *a. The outside dimension from valve cover to valve cover;*
   - *b. The dimensions of the outside edges of the cylinder heads;* ***or***
   - *c. The diameter of the flywheel housing;*

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

f. "Technology" "required" for the "production" of specially designed components, as follows, for high output diesel engines:
   1. "Technology" "required" for the "production" of engine systems having all of the following components employing ceramics materials controlled by 1013.7:
      a. Cylinder liners;
      b. Pistons;
      c. Cylinder heads; and
      d. One or more other components (including exhaust ports, turbochargers, valve guides, valve assemblies or insulated fuel injectors);
   2. "Technology" "required" for the "production" of turbocharger systems, with single-stage compressors having all of the following:
      a. Operating at pressure ratios of 4:1 or higher;
      b. A mass flow in the range from 30 to 130 kg per minute; and
      c. Variable flow area capability within the compressor or turbine sections;
   3. "Technology" "required" for the "production" of fuel injection systems with a specially designed multifuel (e.g., diesel or jet fuel) capability covering a viscosity range from diesel fuel (2.5 cSt at 310.8 K (37.8°C)) down to gasoline fuel (0.5 cSt at 310.8 K (37.8°C)), having both of the following:
      a. Injection amount in excess of 230 mm3 per injection per cylinder; and
      b. 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;

g. "Technology" "required" for the "development" or "production" of high output diesel engines for solid, gas phase or liquid film (or combinations thereof) cylinder wall lubrication, 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.

   ** For information only, 10 arc minutes is equivalent to 2.9 milliradians.*

Group 2 - Munitions List

Note 1:
Terms in "quotations" are defined terms. Refer to 'Definitions of Terms used in these Lists' annexed to this List.
Note 2:
CAS numbers are shown as examples. They do not cover all the chemical and mixtures controlled by the Munitions List

General "Technology" Note
The export of "technology" which is "required" for the "development", "production" or "use" of items controlled in the Munitions List is controlled according to the provisions in the Munitions List entries. This "technology" remains under control even when applicable to an uncontrolled item.
Controls do not apply to that "technology" which is the minimum necessary for the installation, operation, maintenance (checking) and repair of those items which are not controlled or whose export has been authorised.
Controls do not apply to "technology" "in the public domain" or to "basic scientific research" or to the minimum necessary information for patent applications.

2001. Arms and automatic weapons with a calibre of 12.7 mm (calibre of 0.50 inches) or less and accessories, as follows, and specially designed components therefore:

a. Rifles, carbines, revolvers, pistols, shotguns, machine pistols and machine guns; (All destinations)
Note:
2001.a. does not control the following:
1. *Muskets, shotguns, rifles and carbines manufactured earlier than 1938;*
2. *Reproductions of muskets, shotguns, rifles and carbines, the originals of which were manufactured earlier than 1890;*
3. *Revolvers, shotguns, pistols and machine guns manufactured 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, weapons sights and flash suppressors for arms controlled by sub-item 2001.a.
Technical Note
Smooth-bore weapons specially designed for military use as specified in 2001.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

Note 1
2001. does not control 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.
Note 2:
2001. does not control firearms specially designed for dummy ammunition and which are incapable of firing , or being modified to fire, any controlled ammunition.
Note 3
2001. does not control weapons using non-centre fire cased ammunition and which are not of the fully automatic firing type.

2002. Armament or weapons with a calibre greater than 12.7 mm (calibre 0.50 inches), projectors and accessories, as follows, and specially designed components therefore:

a. Guns, howitzers, cannon, mortars, anti-tank weapons, projectile launchers, military flame throwers, recoilless rifles and signature reduction devices therefore; (All destinations)
Note:
2002.a. includes injectors, metering devices, storage tanks and other specially designed components for use with liquid propelling charges for any of the equipment controlled by 2002.a.

b. Military smoke, gas and pyrotechnic projectors or generators; (All destinations)
Note:
2002.b. does not control signal pistols.

c. Weapons sights.

2003. Ammunition, and specially designed components therefore, for the weapons controlled by Items 2001., 2002. or 2012.

(All destinations)

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 initiation devices;
   c. Power supplies with high one-time operational output;
   d. Combustible cases for charges;
   e. Submunitions including bomblets, minelets and terminally guided projectiles.
2. *2003. does not control ammunition crimped without a projectile (blank star) and dummy ammunition with a pierced powder chamber.*
3. *2003 does not control cartridges specially designed for any of the following purposes:*
   a. Signalling:
   b. Bird scaring; ***or***
   c. Lighting of gas flares at oil wells.

2004. Bombs, torpedoes, rockets, missiles, other explosive devices and charges, and related equipment and accessories, as follows, specially designed for military use, and specially designed components therefore:

a. Bombs, torpedoes, grenades, smoke canisters, rockets, mines, missiles, depth charges, demolition-charges, demolition -devices and demolition-kits, "pyrotechnic" devices, cartridges and simulators (i.e. equipment simulating the characteristics of any of these items); *(All destinations)*
Note:
2004.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 controlled by 2004.a.
Note:
2004.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.*

2004.b. notes con't.

Technical Note

Hand-held devices, limited by design solely to the detection of metal objects and incapable of distinguishing between mines and other metal objects, are not considered to be specially designed for the detection of items controlled by 2004.a.

2005. Fire control, and related alerting and warning equipment, and related systems, test and alignment and counter-measure equipment, as follows, specially designed for military use, and specially designed components and accessories therefore:

a. Weapon sights, bombing computers, gun laying equipment and weapon control systems;
b. Target acquisition, designation, range-finding, surveillance or tracking systems; detection, data fusion, recognition or identification equipment; and sensor integration equipment;
c. Countermeasure equipment for Items 2005.a. or 2005.b.;
d. Field test or alignment equipment, specially designed for items controlled by 2005.a. or 2005.b.

2006. Ground vehicles and components therefore specially designed or modified for military use.

Technical Note:

For the purposes of 2006. the term ground vehicles includes trailers.

Note 1:

2006. includes:

a. Tanks and other military armed vehicles and military vehicles fitted with mountings for arms or equipment for mine laying or the launching of munitions controlled under 2004.;
b. Armoured vehicles;
c. Amphibious and deep water fording vehicles;
d. Recovery vehicles and vehicles for towing or transporting ammunition or weapons systems and associated load handling equipment.

Note 2:

Modification of a ground vehicle for military use entails a structural, electrical or mechanical change involving one or more specially designed military components. Such components include:

a. Pneumatic tyre casings of a kind specially designed to be bullet-proof or to run when deflated;
b. Tyre inflation pressure control systems, operated from inside a moving vehicle;
c. Armoured protection of vital parts, (e.g. fuel tanks or vehicle cabs);
d. Special reinforcements for mountings for weapons.

Note 3:

2006. does not control civil automobiles or trucks designed for transporting money or valuables, having armoured protection.

2007. Chemical or biological toxic agents, "tear gases", radioactive materials, related equipment, components, materials and "technology" as follows:

a. Biological agents and radioactive materials "adapted for use in war" to produce casualties in humans or animals, degrade equipment or damage crops or the environment, and chemical warfare (CW) agents;
b. CW binary precursors and key precursors, as follows:
   1. Alkyl (Methyl, Ethyl, n-Propyl or Isopropyl Phosphonyl Difluorides such as: DF: Methyl Phosphonyldifluoride (CAS 676-99-3);
   2. O-Akyl (H or equal to or less than C_{10}, including cycloalkyl) O-2-diakyl (Methyl Ethyl, n-Propyl or Isopropyl) amininoethyl alkyl (Methyl Ethyl, n-Propyl or Isopropyl) phossphonite and corresponding alkylated and protonated salts, such as:
      QL: O-Ethyl-2-di-isopropylaminoethyl methylphos-phonite (CAS 57856-11-8);
   3. Chlorosarin: O-Isopropyl methylphosphonochloridate (CAS 1445-76-7);
   4. Chlorosoman: O-Pinakolyl methylphosphon-ochloridate (CAS 7040-57-5);
c. "Tear gases" and "riot control agents" including:
   1. Bromobenzyl cyanide (CA) (CAS 5798-79-8);
   2. o-Chlorobenzylidenemalononitrile (o-Chlorobenzal-malononitrile) (CS) (CAS 2698-41-1.;
   3. Phenylacyl chloride ((-chloroacetophenone) (CN) (CAS 532-27-4);
   4. Dibenz-(b,f)-1,4-oxazephine (CR) (CAS 257-07-8);
d. Equipment specially designed or modified for the dissemination of any of the following and specially designed components therefore;
   1. Materials or agents controlled by 2007.a or c.; **or**
   2. CW made up of precursors controlled by 2007.b.
e. Equipment specially designed or modified for defence against materials or agents controlled by 2007.a. or c. and specially designed components therefore;
   Note:
   2007.e. includes protective clothing;
f. Equipment specially designed for the detection or identification of materials controlled by 2007.a. or c. and specially designed components therefore;
   Note:
   2007.f. does not control personal radiation monitoring dosimeters.
   N.B.
   For civil gas masks and protective equipment see also Item 1011.4. on the Dual-Use List. (Group 1.
g. "Biopolymers" specially designed or processed for the detection or identification of CW agents controlled by 2007.a., and the cultures of specific cells used to produce them;
h. "Biocatalysts" for the decontamination or degradation of CW agents, and biological systems therefore, as follows:
   1. "Biocatalysts" specially designed for the decontamination or degradation of CW agents controlled by 2007.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" controlled by Item 2007.h.1.;
i. "Technology" as follows:
   1. "Technology" for the "development", "production" or "use" of toxicological agents, related equipment or components controlled by Item 2007.a. to 2007.f.;
   2. "Technology" for the "development", "production" or "use" of "biopolymers" or cultures of specific cells controlled by 2007.g.;
   3. "Technology" exclusively for the incorporation of "biocatalysts", controlled by 2007.h.1., into military carrier substances or military material.

2007.i.3. notes con't.

Notes:

1. 2007.a. includes the following:

a. CW nerve agents:

1. O-Alkyl (equal to or less than C_{10}, including cycloalkyl) alkyl (Methyl, Ethyl, n-Propyl or Isopropyl) - phosphonofluoridates, such as: Sarin (GB): O-Isopropyl methylphosphonofluoridate (CAS 107-44-8); and Soman (GD): O-Pinacolyl methylphosphonofluoridate (CAS 96-64-0);

2. O-Alkyl (equal to or less than C_{10}, 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);

3. O-Alkyl (H or equal to or less than C_{10}, 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);

b. CW vesicant agents:

1. 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);

2. Lewisites, such as:
2-chlorovinyldichloroarsine (CAS 541-25-3);
Tris (2-chlorovinyl) arsine (CAS 40334-70-1);
Bis (2-chlorovinyl) chloroarsine (CAS 40334-69-8);

3. 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);

c. CW incapacitating agents such as: 3 -Quinuclidinyl benzilate (BZ) (CAS 6581-06-2).

d. CW defoliants such as:

1. Butyl 2-chloro-4-flourophenoxyacetate (LNF);

2. 2,4,5,-trichlorophenoxyacetate acid mixed with 2,4-dichlorophenoxyacetic acid (Agent Orange)

2. 2007.e. includes air conditioning units specially designed or modified for nuclear, biological or chemical filtration.

3. Sub-item 2007.a. and 2007.c. do not control:

a. Cyanogen chloride (CAS 506-77-4);
b. Hydrocyanic acid (CAS 74-90-8);
c. Chlorine (CAS 7782-50-5);
d. Carbonyl chloride (phosgene) (CAS 75-44-5);
e. Diphosgene (trichloromethyl-chloroformate) (CAS 503-38-8);
f. Ethyl bromoacetate (CAS 105-36-2);
g. Xylyl bromide, ortho: (CAS 89-92-9), meta: (CAS 620-13-3), para: (CAS 104-81-4);
h. Benzyl bromide (CAS 100-39-0);
i. Benzyl iodide (CAS 620-05-3);
j. Bromo acetone (CAS 598-31-2);
k. Cyanogen bromide (CAS 506-68-3);
l. Bromo methylethylketone (CAS 816-40-0);
m. Chloro acetone (CAS 78-95-5);
n. Ethyl iodoacetate (CAS 623-48-3);
o. Iodo acetone (CAS 3019-04-3);
p. Chloropicrin (CAS 76-06-2).

4. The "technology", cultures of cells and biological systems listed in 2007.g., 2007.h.2. and 2007.i.3. are exclusive and these sub-items do not control "technology", cells or biological systems for civil purposes, such as agricultural, pharmaceutical, medical, veterinary, environmental, waste management, or in the food industry.

5. 2007.c. does not control tear gases or riot control agents individually packaged for personal self defence purposes.

6. 2007.d., 2007.e. and 2007.f. control equipment specially designed or modified for military purposes.

N.B.

See also Group 1: Dual-Use List, Item 1011.4.

2008. "Energetic materials", and related substances, as follows:

N.B.

See also 1013.11 on the Dual-Use List

Note

2008. does not control materials contained in specially formulated pharmaceutical products.

Technical Notes

1. For the purposes of this entry, mixture refers to a composition of two or more substances with at least one substance being listed in the 2008 sub-items.

2. Any substance listed in the 2008 sub-items is controlled by this list, even when utilised in an application other than that indicated. (e.g., TAGN is predominantly used as an explosive but can also be used either as a fuel or an oxidiser.)

a. "Explosives", as follows, and mixtures thereof:
1. ADNBF (aminodinitrobenzofuroxan or 7-amino-4,6-dinitrobenzofurazane-1-oxide) (CAS 97096-78-1);
2. BNCP (cis-bis (5-nitrotetrazolato) tetra amine-cobalt (III) perchlorate) (CAS 117412-28-9);
3. CL-14 (diamino dinitrobenzofuroxan or 5,7-diamino-4,6-dinitrobenzofurazane-1-oxide) (CAS 117907-74-1);
4. CL-20 (HNIW or Hexanitrohexaazaisowurtzitane) (CAS 135285-90-4); chlathrates of CL-20 (see also 2008.g.3. and g.4. for its "precursors"); CP (2-(5-cyanotetrazolato) penta amine-cobalt (III) perchlorate) (CAS 70247-32-4);
6. DADE (1,1-diamino-2,2-dinitroethylene, FOX7);
7. DATB (diaminotrinitrobenzene) (CAS 1630-08-6);
8. DDFP (1,4-dinitrodifurazanopiperazine);
9. DDPO (2,6-diamino-3,5-dinitropyrazine-1-oxide, PZO) (CAS 194486-77-6);
10. DIPAM (3,3¢-diamino-2,2¢,4,4¢,6,6¢-hexanitrobiphenyl or dipicramide) (CAS 17215-44-0);
11. DNGU (DINGU or dinitroglycoluril) (CAS 55510-04-8);
12. Furazans, as follows:
    a. DAAOF (diaminoazoxyfurazan);
    b. DAAzF (diaminoazofurazan) (CAS 78644-90-3);
13. HMX and derivatives (see also 2008.g.5. for its "precursors"), as follows:
    a. HMX (Cyclotetramethylenetetranitramine, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazine, 1,3,5,7-tetranitro-1,3,5,7-tetraza-cyclooctane, octogen or octogene) (CAS 2691-41-0);
    b. difluoroaminated analogs of HMX;
    c. K-55 (2,4,6,8-tetranitro-2,4,6,8-tetraazabicyclo [3,3,0]-octanone-3, tetranitrosemiglycouril or keto-bicyclic HMX) (CAS 130256-72-3);
14. HNAD (hexanitroadamantane) (CAS 143850-71-9);
15. HNS (hexanitrostilbene) (CAS 20062-22-0);
16. Imidazoles, as follows:
    a. BNNII (Octahydro-2,5-bis(nitroimino)imidazo [4,5-d]imidazole);
    b. DNI (2,4-dinitroimidazole) (CAS 5213-49-0);
    c. FDIA (1-fluoro-2,4-dinitroimidazole);
    d. NTDNIA (N-(2-nitrotriazolo)-2,4-dinitroimidazole);
    e. PTIA (1-picryl-2,4,5-trinitroimidazole);
17. NTNMH (1-(2-nitrotriazolo)-2-dinitromethylene hydrazine);
18. NTO (ONTA or 3-nitro-1,2,4-triazol-5-one) (CAS 932-64-9);

2008.a. con't.

19. Polynitrocubanes with more than four nitro groups;
20. PYX (2,6-Bis(picrylamino)-3,5-dinitropyridine) (CAS 38082-89-2); 21. RDX and derivatives, as follows:
    a. RDX (cyclotrimethylenetrinitramine, cyclonite, T4, hexahydro-1,3,5-trinitro-1,3,5-triazine, 1,3,5-trinitro-1,3,5-triaza-cyclohexane, hexogen or hexogene) (CAS 121-82-4);
    b. Keto-RDX (K-6 or 2,4,6-trinitro-2,4,6-triaza-cyclohexanone) (CAS 115029-35-1);
22. TAGN (triaminoguanidinenitrate) (CAS 4000-16-2);
23. TATB (triaminotrinitrobenzene) (CAS 3058-38-6) (see also 2008.g.7 for its "precursors");
24. TEDDZ (3,3,7,7-tetrabis(difluoroamine) octahydro-1,5-dinitro-1,5-diazocine);
25. Tetrazoles, as follows:
    a. NTAT (nitrotriazol aminotetrazole);
    b. NTNT (1-N-(2-nitrotriazolo)-4-nitrotetrazole);
26. Tetryl (trinitrophenylmethylnitramine) (CAS 479-45-8);
27. TNAD (1,4,5,8-tetranitro-1,4,5,8-tetraazadecalin) (CAS 135877-16-6) (see also 2008.g.6. for its "precursors");
28. TNAZ (1,3,3-trinitroazetidine) (CAS 97645-24-4) (see also 2008.g.2. for its "precursors");
29. TNGU (SORGUYL or tetranitroglycoluril) (CAS 55510-03-7);
30. TNP (1,4,5,8-tetranitro-pyridazino[4,5-d]pyridazine) (CAS 229176-04-9);
31. Triazines, as follows:
    a. DNAM (2-oxy-4,6-dinitroamino-s-triazine) (CAS 19899-80-0);
    b. NNHT (2-nitroimino-5-nitro-hexahydro-1,3,5-triazine) (CAS 130400-13-4);
32. Triazoles, as follows:
    a. 5-azido-2-nitrotriazole;
    b. ADHTDN (4-amino-3,5-dihydrazino-1,2,4-triazole dinitramide) (CAS 1614-08-0);
    c. ADNT (1-amino-3,5-dinitro-1,2,4-triazole);
    d. BDNTA ([bis-dinitrotriazole]amine);
    e. DBT (3,3¢-dinitro-5,5-bi-1,2,4-triazole) (CAS 30003-46-4);
    f. DNBT (dinitrobistriazole) (CAS 70890-46-9);
    g. NTDNA (2-nitrotriazole 5-dinitramide) (CAS 75393-84-9);
    h. NTDNT (1-N-(2-nitrotriazolo) 3,5-dinitrotriazole);
    i. PDNT (1-picryl-3,5-dinitrotriazole);
    j. TACOT (tetranitrobenzotriazolobenzotriazole) (CAS 25243-36-1);
33. Any explosive not listed elsewhere in 2008.a. with a detonation velocity exceeding 8,700 m/s at maximum density or a detonation pressure exceeding 34 GPa (340 kbar);
34. Other organic explosives not listed elsewhere in 2008.a. yielding detonation pressures of 25 GPa (250 kbar) or more that will remain stable at temperatures of 523K (250°C) or higher for periods of 5 minutes or longer.

b. "Propellants", as follows:
    1. Any United Nations (UN) Class 1.1 solid "propellant" with a theoretical specific impulse (under standard conditions) of more than 250 seconds for non-metallised, or more than 270 seconds for aluminised compositions;
    2. Any UN Class 1.3 solid "propellant" with a theoretical specific impulse (under standard conditions) of more than 230 seconds for non-halogenised, 250 seconds for non-metallised compositions and 266 seconds for metallised compositions;
    3. "Propellants" having a force constant of more than 1,200 kJ/kg;
    4. "Propellants" that can sustain a steady-state linear burning rate of more than 38 mm/s under standard conditions (as measured in the form of an inhibited single strand) of 6.89 MPa (68.9 bar) pressure and 294K (21°C);
    5. Elastomer modified cast double base (EMCDB) "propellants" with extensibility at maximum stress of more than 5% at 233K (-40°C);
    6. Any "propellant" containing substances listed in 2008.a.

c. "Pyrotechnics", fuels and related substances, as follows, and mixtures thereof:
    1. Aircraft fuels specially formulated for military purposes;
    2. Alane (aluminum hydride) (CAS 7784-21-6);
    3. Carboranes; decaborane (CAS 17702-41-9); pentaboranes (CAS 19624-22-7 and 18433-84-6) and their derivatives;
    4. Hydrazine and derivatives, as follows (see also 2008.d.8. and d.9. for oxidising hydrazine derivatives):
        a. Hydrazine (CAS 302-01-2) in concentrations of 70% or more;
        b. Monomethyl hydrazine (CAS 60-34-4);
        c. Symmetrical dimethyl hydrazine (CAS 540-73-8);
        d. Unsymmetrical dimethyl hydrazine (CAS 57-14-7);
    5. Metal fuels in particle form whether spherical, atomised, spheroidal, flaked or ground, manufactured from material consisting of 99 % or more of any of the following:
        a. Metals and mixtures thereof, as follows:
            1. Beryllium (CAS 7440-41-7) in particle sizes of less than 60 μm;
            2. Iron powder (CAS 7439-89-6) with particle size of 3 μm or less produced by reduction of iron oxide with hydrogen;
        b. Mixtures, which contain any of the following:
            1. Zirconium (CAS 7440-67-7), magnesium (CAS 7439-95-4) or alloys of these in particle sizes of less than 60 μm;
            2. Boron (CAS 7440-42-8) or boron carbide (CAS 12069-32-8) fuels of 85% purity or higher and particle sizes of less than 60 μm;
    6. Military materials containing thickeners for hydrocarbon fuels specially formulated for use in flame throwers or incendiary munitions, such as metal stearates or palmates (e.g. octal (CAS 637-12-7)) and M1, M2, and M3 thickeners;
    7. Perchlorates, chlorates and chromates composited with powdered metal or other high energy fuel components;
    8. Spherical aluminum powder (CAS 7429-90-5) with a particle size of 60 μm or less, manufactured from material with an aluminum content of 99% or more;
    9. Titanium subhydride (TiHn) of stoichiometry equivalent to n= 0.65-1.68.

Note 1

Aircraft fuels controlled by 2008.c.1. are finished products not their constituents.

Note 2

2008.c.4.a. does not control hydrazine mixtures specially formulated for corrosion control.

2008.c. notes con't.

Note 3

Explosives and fuels containing the metals or alloys listed in 2008.c.5. are controlled whether or not the metals or alloys are encapsulated in aluminum, magnesium, zirconium, or beryllium.

Note 4

2008.c.5.b.2. does not control boron and boron carbide enriched with boron-10 (20% or more of total boron-10 content.)

d. Oxidisers, as follows, and mixtures thereof:
   1. ADN (ammonium dinitramide or SR 12) (CAS 140456-78-6);
   2. AP (ammonium perchlorate) (CAS 7790-98-9);
   3. Compounds composed of fluorine and any of the following:
      a. Other halogens;
      b. Oxygen; or
      c. Nitrogen;

      Note

      2008.d.3 does not control chlorine trifluoride.
   4. DNAD (1,3-dinitro-1,3-diazetidine) (CAS 78246-06-7);
   5. HAN (hydroxylammonium nitrate) (CAS 13465-08-2);
   6. HAP (hydroxylammonium perchlorate) (CAS 15588-62-2);
   7. HNF (hydrazinium nitroformate) (CAS 20773-28-8);
   8. Hydrazine nitrate (CAS 37836-27-4);
   9. Hydrazine perchlorate (CAS 27978-54-7);
   10. Liquid oxidisers comprised of or containing inhibited red fuming nitric acid (IRFNA) (CAS 8007-58-7);

       Note

       2008.d.10 does not control non-inhibited fuming nitric acid.

e. Binders, plasticisers, monomers, polymers, as follows:
   1. AMMO (azidomethylmethyloxetane and its polymers) (CAS 90683-29-7) (see also 2008.g.1. for its "precursors");
   2. BAMO (bisazidomethyloxetane and its polymers) (CAS 17607-20-4) (see also 2008.g.1. for its "precursors");
   3. BDNPA (bis (2,2-dinitropropyl)acetal) (CAS 5108-69-0);
   4. BDNPF (bis (2,2-dinitropropyl)formal) (CAS 5917-61-3);
   5. BTTN (butanetrioltrinitrate) (CAS 6659-60-5) (see also 2008.g.8. for its "precursors");
   6. Energetic monomers, plasticisers and polymers containing nitro, azido, nitrate, nitraza or difluoroamino groups specially formulated for military use;
   7. FAMAO (3-difluoroaminomethyl-3-azidomethyl oxetane) and its polymers;
   8. FEFO (bis-(2-fluoro-2,2-dinitroethyl) formal) (CAS 17003-79-1);
   9. FPF-1 (poly-2,2,3,3,4,4-hexafluoropentane-1,5-diol formal) (CAS 376-90-9);
   10. FPF-3 (poly-2,4,4,5,5,6,6-heptafluoro-2-tri-fluoromethyl-3-oxaheptane-1,7-diol formal);
   11. GAP (glycidylazide polymer) (CAS 143178-24-9) and its derivatives;
   12. HTPB (hydroxyl terminated polybutadiene) with a hydroxyl functionality equal to or greater than 2.2 and less than or equal to 2.4, a hydroxyl value of less than 0.77 meq/g, and a viscosity at 30°C of less than 47 poise (CAS 69102-90-5);
   13. Low (less then 10,000) molecular weight, alcohol functionalised, poly(epichlorohydrin); poly(epichloro-hydrindiol) and triol;
   14. NENAs (nitratoethylnitramine compounds) (CAS 17096-47-8, 85068-73-1, 82486-83-7, 82486-82-6 and 85954-06-9);
   15. PGN (poly-GLYN, polyglycidylnitrate or poly (nitra-tomethyl oxirane) (CAS 27814-48-8);
   16. Poly-NIMMO (poly nitratomethylmethyloxetane) or poly-NMMO (poly[3-Nitratomethyl-3-methyloxetane]) (CAS 84051-81-0);
   17. Polynitroorthocarbonates;
   18. TVOPA (1,2,3-tris[1,2-bis(difluoroamino)ethoxy] propane or tris vinoxy propane adduct) (CAS 53159-39-0).

f. "Additives", as follows:
   1. Basic copper salicylate (CAS 62320-94-9);
   2. BHEGA (bis-(2-hydroxyethyl) glycolamide) (CAS 17409-41-5);
   3. BNO (butadienenitrileoxide) (CAS 9003-18-3);
   4. Ferrocene derivatives, as follows:
      a. Butacene (CAS 125856-62-4);
      b. Catocene (2,2-bis-ethylferrocenyl propane) (CAS 37206-42-1);
      c. Ferrocene carboxylic acids;
      d. n-butyl-ferrocene (CAS 319904-29-7);
      e. Other adducted polymer ferrocene derivatives;
   5. Lead beta-resorcylate (CAS 20936-32-7);
   6. Lead citrate (CAS 14450-60-3);
   7. Lead-copper chelates of beta-resorcylate or salicylates (CAS 68411-07-4);
   8. Lead maleate (CAS 19136-34-6);
   9. Lead salicylate (CAS 15748-73-9);
   10. Lead stannate (CAS 12036-31-6); 11. MAPO (tris-1-(2-methyl)aziridinyl phosphine oxide) (CAS 57-39-6); BOBBA 8 (bis(2-methyl aziridinyl) 2-(2-hydroxypropanoxy) propylamino phosphine oxide); and other MAPO derivatives;
   12. Methyl BAPO (bis(2-methyl aziridinyl) methylamino phosphine oxide) (CAS 85068-72-0);
   13. N-methyl-p-nitroaniline (CAS 100-15-2);
   14. 3-Nitraza-1,5-pentane diisocyanate (CAS 7406-61-9);
   15. Organo-metallic coupling agents, as follows:
      a. Neopentyl[diallyl]oxy, tri[dioctyl]phosphato-titanate (CAS 103850-22-2); also known as titanium IV, 2,2[bis 2-propenolato-methyl, butanolato, tris (dioctyl) phosphato] (CAS 110438-25-0); or LICA 12 (CAS 103850-22-2);
      b. Titanium IV, [(2-propenolato-1) methyl, n-propanolatomethyl] butanolato-1, tris[dioctyl] pyrophosphate or KR3538;
      c. Titanium IV, [(2-propenolato-1)methyl, n-propanolato-methyl] butanolato-1, tris(dioctyl)phosphate;
   16. Polycyanodifluoroaminoethyleneoxide;
   17. Polyfunctional aziridine amides with isophthalic, trimesic (BITA or butylene imine trimesamide), isocyanuric or trimethyladipic backbone structures and 2-methyl or 2-ethyl substitutions on the aziridine ring;
   18. Propyleneimine (2-methylaziridine) (CAS 75-55-8);
   19. Superfine iron oxide (Fe2O3) with a specific surface area more than 250 m^2/g and an average particle size of 3.0 nm or less;
   20. TEPAN (tetraethylenepentaamineacrylonitrile) (CAS 68412-45-3); cyanoethylated polyamines and their salts;

2008.f. con't.

21. TEPANOL (tetraethylenepentaamineacrylonitrileglycidol) (CAS 68412-46-4); cyanoethylated polyamines adducted with glycidol and their salts;
22. TPB (triphenyl bismuth) (CAS 603-33-8).

g. "Precursors", as follows:

N.B.

In 2008.g. the references are to controlled "Energetic Materials" manufactured from these substances.

1. BCMO (bischloromethyloxetane) (CAS 142173-26-0) (see also 2008.e.1. and e.2.);
2. Dinitroazetidine-t-butyl salt (CAS 125735-38-8) (see also 2008.a.28.);
3. HBIW (hexabenzylhexaazaisowurtzitane) (CAS 124782-15-6) (see also 2008.a.4.);
4. TAIW (tetraacetyldibenzylhexaazaisowurtzitane) (see also 2008.a.4.);
5. TAT (1,3,5,7 tetraacetyl-1,3,5,7,-tetraaza cyclo-octane) (CAS 41378-98-7) (see also 2008.a.13.);
6. 1,4,5,8-tetraazadecalin (CAS 5409-42-7) (see also 2008.a.27.);
7. 1,3,5-trichlorobenzene (CAS 108-70-3) (see also 2008.a.23.);
8. 1,2,4-trihydroxybutane (1,2,4-butanetriol) (CAS 3068-00-6) (see also 2008.e.5.).

Note 5

For charges and devices see 2004.

Note 6

2008. does not control the following substances unless they are compounded or mixed with the "energetic material" mentioned in 2008.a. or powdered metals in 2008.c.:

a. Ammonium picrate;
b. Black powder;
c. Hexanitrodiphenylamine;
d. Difluoroamine;
e. Nitrostarch;
f. Potassium nitrate;
g. Tetranitronaphthalene;
h. Trinitroanisol;
i. Trinitronaphthalene;
j. Trinitroxylene;
k. N-pyrrolidinone; 1-methyl-2-pyrrolidinone;
l. Dioctylmaleate;
m. Ethylhexylacrylate;
n. Triethylaluminium (TEA), trimethylaluminium (TMA), and otlher pyrophoric metal alkyls and aryls of lithium, sodium, magnesium, zinc or boron;
o. Nitrocelluose;
p. Nitroglycerin (or glyceroltrinitrate, trinitroglycerine) (NG);
q. 2,4,6-trinitrotoluene (TNT);
r. Ethylenediaminedinitrate (EDDN);
s. Pentaerythritoltetranitrate (PETN);
t. Lead azide, normal and basic lead styphnate, and primary explosives or priming compositions containing azides or azide complexes;
u. Triethyleneglycoldinitrate (TEGDN);
v. 2,4,6-trinitroresorcinol (styphnic acid);
w. Diethyldiphenyl urea; dimethylidiphenyl urea; methylethyldiphenyl urea [Centralites];
x. N,N-diphenylurea (unsymmetrical diphenylurea);
y. Methyl-N,N-diphenylurea (methyl unsymmetrical diphenylurea);
z. Ethyl-N,N-diphenylurea (ethyl unsymmetrical diphenylurea);
aa. 2-Nitrodiphenylamine (2-NDPA);
bb. 4-Nitrodiphenylamine (4-NDPA);
cc. 2,2-dinitropropanol;
dd. Nitroguanidine (see 1.C.11. on the Dual-Use List).}

2009. Vessels of war, special naval equipment and accessories, as follows, and components therefore, specially designed for military use :

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 rpm 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:

   2009.f. 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 with gas or magnetic suspension, active signature or vibration suppression controls, and equipment containing those bearings, specially designed for military use.

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 therefore;
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 therefore;
c. Aero-engines specially designed or modified for military use, and specially designed components therefore;
d. Unmanned airborne vehicles and related equipment, specially designed or modified for military use, as follows, and specially designed components therefore:

2010. con't.

1. Unmanned airborne vehicles including remotely piloted air vehicles (RPVs) and autonomous programmable vehicles;
2. Associated launchers and ground support equipment;
3. Related equipment for command and control.

e. Airborne equipment, including airborne refuelling equipment, specially designed for use with the "aircraft" controlled by 2010.a. or 2010.b. or the aero-engines controlled by 2010.c., and specially designed components therefore;

f. Pressure refuellers, pressure refuelling equipment, equipment specially designed to facilitate operations in confined areas and ground equipment, developed specially for "aircraft" controlled by 2010.a. or 2010.b., or for aero-engines controlled by 2010.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 stabilization 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;
   8. Equipment specially designed for high altitude parachutists (e.g. suits, special helmets, breathing systems, navigation equipment);

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. 2010.b. does not control "aircraft" or variants of those "aircraft" specially designed for military use which:
   a. Are not configured for military use and are not fitted with equipment or attachments specially designed or modified for military use; and
   b. Have been certified for civil use by the civil aviation authority in a participating state.

2. 2010.c. does not control:
   a. Aero-engines designed or modified for military use which have been certified by civil aviation authorities in a participating state for use in "civil aircraft", or specially designed components therefore;
   b. Reciprocating engines or specially designed components therefore.

3. The control in 2010.b. and 2010.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 controlled elsewhere on the Munitions List, specially designed for military use and specially designed components therefore.

Note:

This Item includes:

a. Electronic countermeasure and electronic counter-countermeasure 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 countermeasure equipment), including jamming and counter-jamming 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 countermeasures, 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, authentification and keyloader equipment and key management, manufacturing and distribution equipment.

2012. High velocity kinetic energy weapon systems and related equipment, as follows, and specially designed components therefore:

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;

N.B.:

For weapon systems using sub-calibre ammunition or employing solely chemical propulsion, and ammunition therefore, see Items 2001. to 2004.

Notes:

1. 2012. 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. 2012. controls 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. 2012. does not control "technology" for magnetic induction for continuous propulsion of civil transport devices.

2013. Armoured or protective equipment and constructions and components, as follows:

a. Armoured plate as follows:
   1. Manufactured to comply with a military standard or specification; **or**
   2. Suitable for military use;
b. Combinations of metallic and non-metallic materials or combinations thereof specially designed to provide ballistic protection for military systems, and specially designed components therefore;
c. Military helmets;
d. Body armour, and flak suits manufactured according to military standards or specifications, or equivalent, and specially designed components therefore.

Notes:

1. *2013.b. includes materials specially designed to form explosive reactive armour or to construct military shelters.*
2. *2013.c. does not control conventional steel helmets, neither modified or designed to accept, nor equipped with any type of accessory device.*
3. *2013.d. does not control individual suits of body armour for personal protection and accessories therefore when accompanying their users .*

N.B

See also Group 1: Dual-Use List, Item 1011.5.

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

Technical 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. *Item 2014. 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 therefore:

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 controlled by 2015.a. to 2015.e.

   Note:

   2015.f. includes equipment designed to degrade the operation or effectiveness of military imaging systems or to minimise such degrading effects.

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 µs, except in the case of shutters which are an essential part of a high speed camera;
   i. Fibre optic image inverters;
   j. Compound semiconductor photocathodes.
2. *2015. does not control "first generation image intensifier tubes" or equipment specially designed to incorporate "first generation image intensifier tubes".*

   N.B. :

   For the status of weapons sights incorporating "first generation image intensifier tubes" see entries 2001., 2002. and 2005.a.

N.B.:

See also Items 1061.2.a.2. and 1061.2.b. on the Dual-Use List (Group 1).

2016. Forgings, castings and other unfinished products the use of which in a controlled product is identifiable by material composition, geometry or function, and which are specially designed for any products controlled by 2001. to 2004., 2006., 2009., 2010., 2012. or 2019.

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

a. Self-contained diving and underwater swimming apparatus, as follows:
   1. Closed or semi-closed circuit (rebreathing) apparatus specially designed for military use (i.e., specially designed to be non magnetic) ;
   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); **or**
   3. 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 controlled by Group 2, Munitions List;
g. Nuclear power generating equipment or propulsion equipment, including nuclear reactors, specially designed for military use and components therefore specially designed or modified for military use;
h. Equipment and material coated or treated for signature suppression specially designed for military use, other than those controlled elsewhere in Group 2, Munitions List;
i. Simulators specially designed for military "nuclear reactors";
j. Mobile repair shops specially designed to service military equipment;

2017. con't.

k. Field generators specially designed for military use;
l. Containers specially designed for military use.
m. Bridges specially designed for military use.
n. Test models specially designed for the "development" of items controlled by 2004., 2006., 2009., or 2010.

Technical Note:

For the purpose of 2017., 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 the Munitions List, as follows:

a. Specially designed or modified production equipment for the production of products controlled by this List, and specially designed components therefore;
b. Specially designed environmental test facilities and specially designed equipment therefore, for the certification, qualification or testing of products controlled by the Munitions List;
c. Specific production "technology", even if the equipment with which such "technology" is to be used is not controlled;
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 not controlled.

Technical Note:

For the purposes of 2018., the term 'production' includes design, examination, manufacture, testing and checking.

Note:

1. *2018.a. and 2018.b. include the following equipment:*
   a. *Continuous nitrators;*
   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 or more 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 2008.c.8.;*
   j. *Convection current converters for the conversion of materials listed in Item 2008.c.3.*
2. a. *The term 'products referred to in the Munitions List' includes:*
      1. *Products not controlled if inferior to specified concentrations as follows:*
         a. *hydrazine (see 2008.c.4.a.);*
         b. *"Military explosives" (see 2008.);*
      2. *Products not controlled if inferior to technical limits, (i.e. "superconductive" materials not controlled by 1013.5. on the Dual-Use List; "superconductive" electromagnets not controlled by 1031.1.e.3. on the Dual-Use List; "superconductive" electrical equipment excluded from control under Item 2020.b.);*
      3. *Metal fuels and oxidants deposited in laminar form from the vapour phase (see 2008.c.5.);*
   2. b. *The term 'products referred to in the Munitions List' does not include:*
      1 *Signal pistols (see Item 2002.b.);*
      2. *The substances excluded from control under Note 3 to Item 2007.;*
      3. *Personal radiation monitoring dosimeters (see 2007.f.) and masks for protection against specific industrial hazards (see also Group 1, Dual-Use List);*
      4. *Acetylene, propane, liquid oxygen, difluoramine (HNF_2), fuming nitric acid and potassium nitrate powder (see Note 6 to Item 2008.);*
      5. *Aero-engines excluded from control 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 industrial machinery which is not controlled, 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;*
   3. *Note 2.b.8. of 2018. does not release from controls "technology" or production equipment for non-antique small arms, even if used to produce reproductions of antique small arms.*
   4. *2018.d. does not control "technology" for civil purposes, such as agricultural, pharmaceutical, medical, veterinary, environmental, waste management, or in the food industry (see Note 4 to Item 2007.).*

2019. Directed energy weapon systems (DEW), related or countermeasure equipment and test models, as follows, and specially designed components therefore:

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 controlled by 2019.a., 2019.b. or 2019.c.;
e. Physical test models and related test results for the systems, equipment and components controlled by this Item.
f. Continuous wave or pulsed "laser" systems specially designed to cause permanent blindness to unenhanced vision, i.e., to the naked eye or to the eye with corrective eyesight devices.

Notes:

1. *Directed energy weapon systems controlled by 2019. 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. *2019. 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 neutralizing negative hydrogen isotope beams.*

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

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 103K (-170°C);
Note:
2020.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:
2020.b. does not control 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.

2021. "Software", as follows:

a. "Software" specially designed or modified for the "development", "production" or "use" of equipment or materials controlled by the Munitions List;
b. Specific "software", as follows:
   1. "Software" specially designed for:
      a. Modeling, simulation or evaluation of military weapon systems;
      b. "Development", monitoring, maintenance or up-dating of "software" embedded in military weapon systems;
      c. Modeling or simulating military operation scenarios, not controlled by 2014.;
      d. Command, Communications, Control and Intelligence (C^3I) or Command, Communications, Control, Computer and Intelligence (C^4I) applications;
   2. "Software" for determining the effects of conventional, nuclear, chemical or biological warfare weapons.
   3. "Software", not controlled by 2021.a., b.1. or b.2., specially designed or modified to enable equipment not controlled by the Munitions List to perform the military functions of equipment controlled by 2005, 2007.f., 2009.c, 2009.e., 2010.e., 2011, 2014, 2015, 2017.i., or 2018.

2022. "Technology" according to the General Technology Note of the Munitions List for the "development", "production" or "use" of items controlled in the Munitions List, other than that "technology" controlled in Items 2007. and 2018.

Definitions for Terms in Groups 1 and 2

"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 humans 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.

"All compensations available"

"All compensations available" means after all feasible measures available to the manufacturer to minimise all systematic positioning errors for the particular machine-tool model are considered.

"Allocated by the ITU"

The allocation of frequency bands according to the ITU Radio Regulations (Edition 1998) for primary, permitted and secondary services.

N.B. *Additional and alternative allocations are not included.*

"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').

"Asymmetric algorithm "

A cryptographic algorithm using different, mathematically-related keys for encryption and decryption.

Technical Note

A common use of "asymmetric algorithms" is key management.

"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.

"ATM"

"ATM" is equivalent to "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.

"Basic gate propagation delay time"

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

Technical Notes

1. *"Basic gate propagation delay time" is not to be confused with the input/output delay time of a complex "monolithic integrated circuit".*
2. *'Family' consists of all integrated circuits to which all of the following are applied as their manufacturing methodology and specifications except their respective functions:*
   a. *The common hardware and software architecture;*
   b. *The common design and process technology; and*
   c. *The common basic characteristics.*

"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.

"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' means "biocatalysts" for specific chemical or biochemical reactions.

"Biopolymers"

Biological macromolecules as follows:

a. Enzymes for specific chemical or biochemical reactions;
b. Antibodies, monoclonal, polyclonal or anti-idiotypic;
c. Specially designed or specially processed receptors;

Technical Notes

N.B.1: *'Anti-idiotypic antibodies' means antibodies which bind to the specific antigen binding sites of other antibodies;*

N.B.2: *'Monoclonal antibodies' means proteins which bind to one antigenic site and are produced by a single clone of cells;*

N.B.3: *'Polyclonal antibodies' means A mixture of proteins which bind to the specific antigen and are produced by more than one clone of cells;*

N.B.4: *'Receptors' means 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).

"Carbon fibre preforms"

An ordered arrangement of uncoated or coated fibres intended to constitute a framework of a part before the "matrix" is introduced to form a "composite".

"CE"

"CE" is equivalent to "computing element".

"Chemical Laser"

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

"Circuit element"

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

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

Control systems using 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.

"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"

N.B.: *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".

"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).

"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 unauthorised 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"

"CTP" is equivalent to "Composite theoretical performance".

"Data-Based Referenced Navigation" ("DBRN") Systems

Systems which use various sources of previously measured geo-mapping data integrated to provide accurate navigation information under dynamic conditions. Data sources include bathymetric maps, stellar maps, gravity maps, magnetic maps or 3-D digital terrain maps.

"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 synchronization functions are to be included.

N.B.1: *When determining the "data signalling rate", servicing and administrative channels shall be excluded.*

N.B.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 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.

"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, perform all of the following:

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").

"Direct-acting hydraulic pressing"

A deformation process which uses a fluid-filled flexible bladder in direct contact with the workpiece.

"Discrete component"

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

"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.

"Effective gram"

"Effective gram" for plutonium isotope is defined as the isotope weight in grams.

"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 (both in transmission and reception) in azimuth or in elevation, or both, by application, both in transmission and reception, of an electrical signal.

"Electronic 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.

"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.

Technical Note:

'Active tooling units' are devices for applying motive power, process energy or sensing to a workpiece.

"Energetic materials"

Substances or mixtures that react chemically to release energy required for their intended application. "Explosives", "pyrotechnics" and "propellants" are subclasses of energetic materials.

"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).

"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 applications, are required to detonate.

"Expression Vectors"

Carriers (e.g., plasmid or virus) used to introduce genetic material into host cells.

"FADEC"

Full Authority Digital Engine Control (FADEC) - an electronic control system for gas turbine or combined cycle engines utilizing a digital computer to control the variables required to regulate engine thrust or shaft power output throughout the engine operating range from the beginning of fuel metering to fuel shutoff.

"Family"

Consists of microprocessor or microcomputer microcircuits, having all of the following:

a. The same architecture;
b. The same basic instruction set; **and**
c. The same basic "technology" (e.g., only NMOS or only CMOS).

"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".

"First generation image intensifier tubes"

Electrostatically focused tubes, employing input and output fibre optic or glass face plates, multi-alkali photocathodes (S-20 or S-25), but not microchannel plate amplifiers.

"Fixed"

The coding or compression algorithm cannot accept externally supplied parameters (e.g., cryptographic or key variables) and cannot be modified by the user.

"Flight control optical sensor array"

A network of distributed optical sensors, using "laser" beams, to provide real-time flight control data for on-board processing.

"Flight path optimization"

A procedure that minimises deviations from a four-dimensional (space and time) desired trajectory based on maximizing performance or effectiveness for mission tasks.

"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.*

"Fractional bandwidth"

The "instantaneous bandwidth" divided by the centre frequency, expressed as a percentage.

"Frequency hopping "

A form of "spread spectrum" in which the transmission frequency of a single communication channel is made to change by a random or pseudo -random sequence of discrete steps.

"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 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 any of the following:

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.

"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 recognise 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 perform all of the following:

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.

"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.

"Interconnected radar sensors"

Two or more radar sensors are interconnected when they mutually exchange data in real time.

"In the public domain"

This 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.

"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"

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 having all of the following characteristics:

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).

Technical Note:
'Data device' means 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.

"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: ISO 10360-2, or VDI/VDE2617).

"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.

"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.

"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.

"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.*

N.B.2: *This definition includes chip sets which are designed to operate together to provide the function of a "microprocessor microcircuit".*

"Microprogramme"

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

"Military 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 pyrotechnics"

Mixtures of solid or liquid fuels and oxidisers 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 oxidisers 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.

"Monospectral imaging sensors"

Are capable of acquisition of imaging data from one discrete spectral band.

"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 $S^2 pp = 8N_o(f2-f1)$, where Spp is the peak-to-peak value of the signal (e.g., nanoteslas), N_o is the power spectral density (e.g., $(nanotesla)^2/Hz$) and (f2-f1) 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"

"Object code": 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.

"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.).

"Peak power"

Energy per pulse in joules divided by the pulse duration in seconds.

"Personalised smart card"

A smart card containing a microcircuit which has been programmed for a specific application and cannot be re-programmed for any other application 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"

Speciality chemicals used in the manufacture of explosives.

"Previously separated"

The application of any process intended to increase the concentration of the controlled isotope.

"Primary flight control"

"Aircraft" stability or manoeuvering control using force/moment generators, i.e., aerodynamic control surfaces or propulsive thrust vectoring.

"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.

"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.

"Propellants"

Substances or mixtures that react chemically to produce large volumes of hot gases at controlled rates to perform mechanical work.

"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.

"Pyrotechnic(s)"

Mixtures of solid or liquid fuels and oxidisers 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 oxidisers but ignite spontaneously on contact with air.

"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 analyser 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 controlled 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 atomisation"

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"

"SDH" is equivalent to "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"

"SHPL" is equivalent to "Super High Power Laser".

"Signal analyzers"

Apparatus capable of measuring and displaying basic properties of the single-frequency components of multi-frequency signals.

"Signal processing"

The processing of externally derived information-bearing signals by algorithms such as time compression, filtering, extraction, selection, correlation, convolution or transformations between domains (e.g., fast Fourier transform or Walsh transform).

"Software"

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

"Solidify rapidly"

A process involving the solidification of molten material at cooling rates exceeding 1,000 K/sec.

"SONET"

"SONET" is equivalent to "Synchronous Optical Network"

"Source code"

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.

"Spectral efficiency"

A figure of merit parameterised to characterise 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:

$$\text{"Spectral efficency"} = \frac{\text{"Digital transfer rate"(bits/sec)}}{\text{6 dB spectrum bandwidth (Hz)}}$$

"Splat quenching"

A process to "solidify rapidly" a molten metal stream impinging upon a chilled block, forming a flake-like product.

"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"

"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.

"Substrate blanks"

Monolithic compounds with dimensions suitable for the production of optical elements such as mirrors or optical windows.

"Superalloy"

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.

"Symmetric algorithm"

A cryptographic algorithm using an identical key for both encryption and decryption.

Technical Note

A common use of "symmetric algorithms" is confidentiality of data.

"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"

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 published. The first level rate of "SDH" is 155.52 Mbit/s.

"Synchronous Optical Network"

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").

"System 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". Controlled "technology" is defined in the General Technology Note and in the Dual-Use 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.

N.B.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 control of flight"

Automated control of "aircraft" state variables and flight path to meet mission objectives responding to real time changes in data regarding objectives, hazards or other "aircraft".

"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".

"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 atomisation"

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.

Acronyms and Abbreviations in Groups 1 and 2

An acronym or abbreviation, when used as a defined term, will be found in 'Definitions of Terms used in these Lists'.

ABEC	Annular Bearing Engineers Committee
AGMA	American Gear Manufacturers' Association
AHRS	attitude and heading reference systems
ALU	arithmetic logic unit
ATC	air traffic control
C^3I	command, communications, control & intelligence
C^4I	command, communications, control, computer and intelligence
CAD	computer-aided-design
CAS	Chemical Abstracts Service
CDU	control and display unit
CEP	circular error probable
CNTD	controlled nucleation thermal deposition
CVD	chemical vapour deposition
CW	chemical warfare
CW (for lasers)	continuous wave
DEW	directed energy weapon systems
DME	distance measuring equipment
DS	directionally solidified
EB-PVD	electron beam physical vapour deposition
EBU	European Broadcasting Union
ECM	electro-chemical machining
ECR	electron cyclotron resonance
EDM	electrical discharge machines
EEPROMS	electrically erasable programmable read only memory
EIA	Electronic Industries Association
EMC	electromagnetic compatibility
EMCDB	elastomer modified cast double based propellants
FFT	Fast Fourier Transform
GLONASS	global navigation satellite system
GPS	global positioning system
HBT	hetero-bipolar transistors
HDDR	high density digital recording
HEMT	high electron mobility transistors
ICAO	International Civil Aviation Organisation
IEC	International Electro-technical Commission
IEEE	Institute of Electrical and Electronic Engineers
IFOV	instantaneous-field-of-view
ILS	instrument landing system
IRIG	inter-range instrumentation group
ISAR	inverse synthetic aperture radar
ISO	International Organization for Standardization
ITU	International Telecommunication Union
JIS	Japanese Industrial Standard
JT	Joule-Thomson
LIDAR	light detection and ranging
LRU	line replaceable unit
MAC	message authentication code
Mach	ratio of speed of an object to speed of sound (after Ernst Mach)
MLS	microwave landing systems
MOCVD	metal organic chemical vapour deposition
MRI	magnetic resonance imaging
MTBF	mean-time-between-failures
Mtops	million theoretical operations per second
MTTF	mean-time-to-failure
NBC	Nuclear, Biological and Chemical
NDT	non-destructive test
PAR	precision approach radar
PIN	personal identification number
ppm	parts per million
PSD	power spectral density
QAM	quadrature-amplitude-modulation
RF	radio frequency
RPV	remotely piloted air vehicles
SACMA	Suppliers of Advanced Composite Materials Association
SAR	synthetic aperture radar
SC	single crystal
SLAR	sidelooking airborne radar
SMPTE	Society of Motion Picture and Television Engineers
SRA	shop replaceable assembly
SRAM	static random access memory
SRM	SACMA Recommended Methods
SSB	single sideband
SSR	secondary surveillance radar
TCSEC	trusted computer system evaluation criteria
TIR	total indicated reading
UTS	ultimate tensile strength
VOR	very high frequency omni-directional range
YAG	yttrium/aluminum garnet

Group 3 - Nuclear Non-Proliferation List

Category 3000: Controlled Nuclear Substances

3001. Special fissionable material, as follows:

1. 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 pacemakers; and
2. uranium 233, uranium enriched in the isotopes 235 or 233 and all alloys and compounds and any material that contains any of the foregoing.

3002. Source material

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 %, 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.

3003. Deuterium and heavy water

Deuterium, heavy water (deuterium oxide) and any other deuterium compound in which the ratio of deuterium to hydrogen atoms exceeds 1:5,000.

3006. Nuclear-grade Graphite

Graphite having a purity level better than 5 ppm boron equivalent and with a density greater than 1.50 g/cm^3.

3012. Tritium

Tritium, tritium compounds or mixtures containing tritium in which the ratio of tritium to hydrogen by atoms exceeds 1 part in 1000 and products containing any of the foregoing.

Category 3100: Controlled Nuclear Equipment

3101. Nuclear reactors and especially designed or prepared equipment therefore including:

1. **Complete nuclear reactors**
   Nuclear reactors capable of operation so as to maintain a controlled self-sustaining fission chain reaction.
2. **Nuclear reactor vessels**
   Metal vessels, or major shop-fabricated parts therefore, especially designed or prepared to contain the core of a nuclear reactor as well as relevant reactor internals as defined in 3101.8.
3. **Nuclear reactor fuel charging and discharging machines**
   Manipulative equipment especially designed or prepared for inserting or removing fuel in a nuclear reactor.
4. **Nuclear reactor control rods and equipment**
   Especially designed or prepared rods, support or suspension structures therefore, rod drive mechanisms or rod guide tubes to control the fission process in a nuclear reaction.
5. **Nuclear reactor pressure tubes**
   Tubes which are especially designed or prepared to contain fuel elements and the primary coolant in a nuclear reactor at an operating pressure in excess of 50 atmospheres.
6. **Zirconium tubes**
   Zirconium metal and alloys in the form of tubes or assemblies of tubes especially designed or prepared for use in a nuclear reactor and in which the relation of hafnium to zirconium is less than 1:500 parts by weight.
7. **Primary coolant pumps**
   Pumps especially designed or prepared for circulating the primary coolant for nuclear reactors.
8. **Nuclear reactor internals**
   Nuclear reactor internals especially designed or prepared for use in a nuclear reactor including support columns for the core, fuel channels, thermal shields, baffles, core grid plates and diffuser plates.
9. **Heat exchangers**
   Heat exchangers (steam generators) especially designed or prepared for use in the primary coolant circuit of a nuclear reactor.
10. **Neutron detection and measuring instruments**
    Especially designed or prepared neutron detection and measuring instruments for determining neutron flux levels within the core of a nuclear reactor.

3103. Plants for the reprocessing of irradiated fuel elements, and equipment especially designed or prepared therefore, including:

1. **Irradiated fuel element chopping machines**
   Remotely operated equipment especially designed or prepared for use in a reprocessing plant as identified above and intended to cut, chop or shear irradiated nuclear fuel assemblies, bundles or rods.
2. **Dissolvers**
   Critically safe tanks (e.g., small diameter, annular or slab tanks) especially designed or prepared for use in a reprocessing plant as identified above, intended for dissolution of irradiated nuclear fuel and which are capable of withstanding hot, highly corrosive liquid, and which can be remotely loaded and maintained.
3. **Solvent extractors and solvent extraction equipment**
   Especially designed or prepared solvent extractors such as packed or pulse columns, mixer settlers or centrifugal contactors for use

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in a plant for the reprocessing of irradiated fuel. Solvent extractors must be resistant to the corrosive effect of nitric acid. Solvent extractors are normally fabricated to extremely high standards (including special welding and inspection and quality assurance and quality control techniques) out of low carbon stainless steels, titanium, zirconium or other high-quality materials.

4. Chemical holding or storage vessels

Especially designed or prepared holding or storage vessels for use in a plant for the reprocessing of irradiated fuel. The holding or storage vessels must be resistant to the corrosive effect of nitric acid. The holding or storage vessels are normally fabricated of materials such as low carbon stainless steels, titanium or zirconium, or other high-quality materials. Holding or storage vessels may be designed for remote operation and maintenance and may have the following features for control of nuclear criticality:

a. walls or internal structures with a boron equivalent of at least 2%;
b. a maximum diameter of 175 mm (7 in.) for cylindrical vessels; **or**
c. a maximum width of 75 mm (3 in.) for either a slab or annular vessel.

3104. Plants for the fabrication of fuel elements, and equipment especially designed or prepared therefore, including equipment which,

1. normally comes in direct contact with, or directly processes, or controls, the production flow of nuclear material;
2. seals the nuclear material within the cladding;
3. checks the integrity of the cladding or the seal; **or**
4. checks the finish treatment of the sealed fuel.

3105. Plants for the separation of isotopes of uranium and equipment, other than analytical instruments, especially designed or prepared therefore including:

1. Gas centrifuges and assemblies and components especially designed or prepared for use in gas centrifuges, including:
   a. Rotating components
      1. complete rotor assemblies:
         thin-walled cylinders, or a number of interconnected thin-walled cylinders, manufactured from one or more high strength to density ratio materials. If interconnected, the cylinders are joined together by flexible bellows or rings as described in paragraph 3. The rotor is fitted with an internal baffle(s) and end caps, as described in paragraphs 4. and 5., if in final form. However the complete assembly may be delivered only partly assembled;
      2. rotor tubes:
         especially designed or prepared thin-walled cylinders with thickness of 12 mm (0.5 in.) or less, a diameter of between 75 mm (3 in.) and 400 mm (16 in.), and manufactured from one or more high strength to density ratio materials;
      3. rings or bellows:
         components especially designed or prepared to give localised support to the rotor tube or to join together a number of rotor tubes. The bellows is a short cylinder of wall thickness 3 mm (0.12 in.) or less, a diameter of between 75 mm (3 in.) and 400 mm (16 in.), having a convolute, and manufactured from high strength to density ratio materials;
      4. baffles:
         disc-shaped components of between 75 mm (3 in.) and 400 mm (16 in.) diameter especially designed or prepared to be mounted inside the centrifuge rotor tube, in order to isolate the take-off chamber from the main separation chamber and, in some cases, to assist the UF_6 gas circulation within the main separation chamber of the rotor tube, and manufactured high strength to density ratio materials; **and**
      5. top caps / bottom caps:
         disc-shaped components of between 75 mm (3 in.) and 400 mm (16 in.) diameter especially designed or prepared to fit to the ends of the rotor tube, and so contain the UF_6 within the rotor tube, and in some cases to support, retain or contain as an integrated part an element of the upper bearing (top cap) or to carry the rotating elements of the motor and lower bearing (bottom cap), and manufactured from high strength to density ratio materials.
   b. Static components
      1. magnetic suspension bearings:
         especially designed or prepared bearing assemblies consisting of an annular magnet suspended within a housing containing a damping medium. The housing will be manufactured from a UF_6-resistant material. The magnet couples with a pole piece or a second magnet fitted to the top cap described in item 3105.1.a.5. The magnet may be ring-shaped with a relation between outer and inner diameter smaller or equal to 1.6:1. The magnet may be in a form having an initial permeability of 0.15 H/m (120,000 in CGS units) or more, or a remanence of 98.5% or more, or an energy product of greater than 80 kJ/m^3 (107 gauss-oersteds). In addition to the usual material properties, it is a prerequisite that the deviation of the magnetic axes from the geometrical axes is limited to very small tolerances (lower than 0.1 mm or 0.004 in.) or that homogeneity of the material of the magnet is specially called for;
      2. bearings / dampers:
         especially designed or prepared bearings comprising a pivot/cup assembly mounted on a damper. The pivot is normally a hardened steel shaft with a hemisphere at one end with a means of attachment to the bottom cap described in item 3105.1.a.5 at the other. The shaft may however have a hydrodynamic bearing attached. The cup is pellet-shaped with a hemispherical indentation in one surface. These components are often supplied separately to the damper;
      3. molecular pumps:
         especially designed or prepared cylinders having internally machined or extruded helical grooves and internally machined bores. Typical dimensions are as follows: 75 mm (3 in.) to 400 mm (16 in.) internal diameter, 10 mm (0.4 in.) or more wall thickness, with the length equal to or greater than the diameter. The grooves are typically rectangular in cross-section and 2 mm (0.08 in.) or more in depth;

3105.b. con't.

4. motor stators:
   especially designed or prepared ring-shaped stators for high speed multiphase AC hysteresis (or reluctance) motors for synchronous operation within a vacuum in the frequency range of 600 Hz to 2,000 Hz and a power range of 50 VA to 1,000 VA. The stators consist of multiphase windings on a laminated low loss iron core comprised of thin layers typically 2 mm (0.08 in.) thick or less;
5. centrifuge housing / recipients:
   components especially designed or prepared to contain the rotor tube assembly of a gas centrifuge. The housing consists of a rigid cylinder of wall thickness up to 30 mm (1.2 in.) with precision machined ends to locate the bearings and with one or more flanges for mounting. The machined ends are parallel to each other and perpendicular to the cylinder's longitudinal axis to within 0.05_ or less. The housing may also be a honeycomb type structure to accommodate several rotor tubes. The housings are made of or protected by materials resistant to corrosion by UF_6; **and**
6. scoops:
   especially designed or prepared tubes of up to 12 mm (0.5 in.) internal diameter for the extraction of UF6 gas from within the rotor tube by a Pitot tube action (that is, with an aperture facing into the circumferential gas flow within the rotor tube, for example by bending the end of a radially disposed tube) and capable of being fixed to the central gas extraction system. The tubes are made of or protected by materials resistant to corrosion by UF_6.

2. Especially designed or prepared auxiliary systems, equipment and components for gas centrifuge enrichment plants including:
   a. Feed systems/product and tails withdrawal system
   Especially designed or prepared process systems including:
   1. feed autoclaves (or stations), used for passing UF6 to the centrifuge cascades at up to 100 kPa (15 psi) and at a rate of 1 kg/h or more;
   2. desublimers (or cold traps) used to remove UF6 from the cascades at up to 3 kPa (0.5 psi) pressure. The desublimers are capable of being chilled to 203 K (-70° C) and heated to 343 K (70° C); **and**
   3. product and tails stations used for trapping UF_6 into containers.

   This plant, equipment and pipework is wholly made of or lined with UF_6-resistant materials and is fabricated to very high vacuum and cleanliness standards.

   b. Machine header piping systems
   Especially designed or prepared piping systems and header systems for handling UF_6 within the centrifuge cascades. The piping network is normally of the triple header system with each centrifuge connected to each of the headers. There is thus a substantial amount of repetition in its form. It is wholly made of UF_6-resistant materials and is fabricated to very high vacuum and cleanliness standards.

   c. UF_6 mass spectrometers / ion sources
   Especially designed or prepared magnetic or quadrupole mass spectrometers capable of taking on-line samples of feed, product or tails, from UF_6 gas streams and having all of the following characteristics:
   1. unit resolution for atomic mass unit greater than 320;
   2. ion sources constructed of or lined with nichrome or monel or nickel-plated;
   3. electron bombardment ionization sources; **and**
   4. having a collector system suitable for isotopic analysis.

   d. Frequency changers
   Frequency changers (also known as converters or invertors) especially designed or prepared to supply motor stators as defined under 3105.1.b.4., or parts, components and sub-assemblies of such frequency changers having all of the following characteristics:
   1. a multiphase output of 600 to 2000 Hz;
   2. high stability (with frequency control better than 0.1%);
   3. low harmonic distortion (less than 2%); and
   4. an efficiency of greater than 80%.

3. Especially designed or prepared assemblies and components for use in gaseous diffusion enrichment, including:
   a. Gaseous diffusion barriers
   1. Especially designed or prepared thin, porous filters, with a pore size of 100 Å to 1,000 Å (angstroms), a thickness of 5 mm (0.2 in.) or less and for tubular forms, a diameter of 25 mm (1 in.) or less, made of metallic, polymer or ceramic materials resistant to corrosion by UF_6; **and**
   2. especially prepared compounds or powders for the manufacture of such filters. Such compounds and powders include nickel or alloys containing 60% or more nickel, aluminum oxide, or UF_6-resistant fully fluorinated hydrocarbon polymers having a purity of 99.9% or more, a particle size less than 10 microns, and a high degree of particle size uniformity, which are especially prepared for the manufacture of gaseous diffusion barriers.

   b. Diffuser housings
   Especially designed or prepared hermetically sealed cylindrical vessels greater than 300 mm (12 in.) in diameter and greater than 900 mm (35 in.) in length, or rectangular vessels of comparable dimensions, which have an inlet connection and two outlet connections all of which are greater than 50 mm (2 in.) in diameter, for containing the gaseous diffusion barrier, made of or lined with UF_6-resistant materials and designed for horizontal or vertical installation.

   c. Compressors and gas blowers
   Especially designed or prepared axial, centrifugal, or positive displacement compressors, or gas blowers with a suction volume capacity of 1 m^3/min or more UF_6, and with a discharge pressure of up to several hundred kPa (100 psi), designed for long-term operation in the UF_6 environment with or without an electrical motor of appropriate power, as well as separate assemblies of such compressors and gas blowers. These compressors and gas blowers have a pressure ratio between 2:1 and 6:1 and are made of, or lined with, materials resistant to UF_6.

   d. Rotary shaft seals
   Especially designed or prepared vacuum seals, with seal feed and seal exhaust connections, for sealing the shaft connecting the compressor or the gas blower rotor with the driver motor so as to ensure a reliable seal against in-leaking of air into the inner chamber of the compressor or gas blower which is filled with UF_6. Such seals are normally designed for a buffer gas in-leakage rate of less than 1,000 cm^3/min (60 in^3/min);

   e. Heat exchangers for cooling UF_6
   Especially designed or prepared heat exchangers made of or lined with UF_6-resistant materials (except stainless steel) or with copper or any combination of those metals, and intended for a leakage pressure change rate of less than 10 Pa/h (0.0015 psi/h) under a pressure difference of 100 kPa (15 psi).

3105. con't.

4. Especially designed or prepared auxiliary systems, equipment and components for use in gaseous diffusion enrichment including:
   - **a. Feed systems/product and tails withdrawal systems**
     Especially designed or prepared process systems, capable of operating at pressures of 300 kPa (45 psi) or less, including:
     1. feed autoclaves (or systems) used for passing UF_6 to the gaseous diffusion cascades;
     2. desublimers (or cold traps) used to remove UF_6 from diffusion cascades;
     3. liquefaction stations where UF_6 gas from the cascade is compressed and cooled to form liquid UF_6; and
     4. products and tails stations used for transferring UF_6 into containers.
   - **b. Header piping systems**
     Especially designed or prepared piping systems and header systems for handling UF_6 within the gaseous diffusion cascades. This piping network is normally of the double header system with each cell connected to each of the headers.
   - **c. Vacuum systems**
     1. especially designed or prepared large vacuum manifolds, vacuum headers and vacuum pumps having a suction capacity of 5 m^3/min (175 ft^3/min) or more; and
     2. vacuum pumps especially designed or prepared for service in UF_6-bearing atmospheres atmospheres made of, or lined with, aluminum, nickel, or alloys bearing more than 60% nickel. These pumps may be either rotary or positive, may have displacement and fluorocarbon seals, and may have special working fluids present.
   - **d. Special shut-off and control valves**
     Especially designed or prepared manual or automated shut-off and control bellows valves made of UF_6-resistant materials with a diameter of 40 to 1,500 mm (1.5 to 59 in.) for installation in main and auxiliary systems of gaseous diffusion enrichment plants.
   - **e. UF_6 mass spectrometers / ion sources**
     'Especially designed or prepared magnetic or quadrupole mass spectrometers capable of taking on-line samples or feed, product or tails, from UF_6 gas streams and having all of the following characteristics:
     1. unit resolution for atomic mass unit greater than 320;
     2. ion sources constructed of or lined with nichrome or monel or nickel-plated;
     3. electron bombardment ionization sources; **and**
     4. collector system suitable for isotopic analysis.
5. Especially designed or prepared systems, equipment and components for use in aerodynamic enrichment plants including:
   - **a. Separation nozzles**
     Especially designed or prepared separation nozzles and assemblies thereof. The separation nozzles consist of slit-shaped, curved channels having a radius of curvature less than 1 mm (typically 0.1 to 0.05 mm), resistant to corrosion by UF_6 and having a knife-edge within the nozzle that separates the gas flowing through the nozzle into two fractions.
   - **b. Vortex tubes**
     Especially designed or prepared vortex tubes and assemblies thereof. The vortex tubes are cylindrical or tapered, made of or protected by materials resistant to corrosion by UF_6, having a diameter of between 0.5 cm and 4 cm, a length to diameter ratio of 20:1 or less, one or more tangential inlets. The tubes may be equipped with nozzle-type appendages at either or both ends.
   - **c. Compressors and gas blowers**
     Especially designed or prepared axial, centrifugal or positive displacement compressors or gas blowers made of or protected by materials resistant to corrosion by UF_6 and with a suction volume capacity of 2 m^3/min or more of UF_6/carrier gas (hydrogen or helium) mixture.
   - **d. Rotary shaft seals**
     Especially designed or prepared rotary seals, with seal feed and seal exhaust connections, for sealing the shaft connecting the compressor rotor or the gas blower rotor with the driver motor so as to ensure a reliable seal against out-leakage of process gas or in-leakage of air or seal gas into the inner chamber of the compressor or gas blower which is filled with a UF_6/carrier gas mixture;
   - **e. Heat exchangers for gas cooling**
     Especially designed or prepared heat exchangers made of or protected by materials resistant to corrosion by UF_6.
   - **f. Separation element housings**
     Especially designed or prepared separation element housings, made of or protected by materials resistant to corrosion by UF_6, for containing vortex tubes or separation nozzles.
   - **g. Feed systems/product and tails withdrawal systems**
     Especially designed or prepared process systems or equipment for enrichment plants made of or protected by materials resistant to corrosion by UF_6, including:
     1. feed autoclaves, ovens, or systems used for passing UF_6 to the enrichment process;
     2. desublimers (or cold traps) used to remove UF_6 from the enrichment process for subsequent transfer upon heating;
     3. solidification or liquefaction stations used to remove UF_6 from the enrichment process by compressing and converting UF_6 to a liquid or solid form; **and**
     4. product or tails stations used for transferring UF_6 into containers.
   - **h. Header piping systems**
     Especially designed or prepared header piping systems, made of or protected by materials resistant to corrosion by UF_6, for handling UF_6 within the aerodynamic cascades. This piping network is normally of the double header design with each stage or group of stages connected to each of the headers.
   - **i. Vacuum systems and pumps**
     1. specially designed or prepared vacuum systems having a suction capacity of 5 m^3/min or more, consisting of vacuum manifolds, vacuum headers and vacuum pumps, and designed for service in UF_6-bearing atmospheres; **and**
     2. vacuum pumps especially designed or prepared for service in UF_6-bearing atmospheres and made of or protected by materials resistant to corrosion by UF_6. These pumps may use fluorocarbon seals and special working fluids.
   - **j. Special shut-off and control valves**
     Especially designed or prepared manual or automated shut-off and control bellows valves made of or protected by materials resistant to corrosion by UF_6 with a diameter of 40 mm to 1,500 mm for installation in main and auxiliary systems of aerodynamic enrichment plants;
   - **k. UF_6 mass spectrometers / ion sources**
     Especially designed or prepared magnetic or quadrupole

3105.5.k. con't.

mass spectrometers capable of taking on-line samples of feed, product or tails from UF_6 gas streams and having all of the following characteristics:

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; and
4. collector system suitable for isotopic analysis.

l. UF_6 /carrier gas separation systems
Especially designed or prepared process systems for separating UF_6 from carrier gas (hydrogen or helium).

6. Especially designed or prepared systems, equipment and components for use in chemical exchange or ion exchange enrichment plants, including:
   a. Liquid-liquid exchange columns (chemical exchange)
   Countercurrent liquid-liquid exchange columns having mechanical power input (i.e., pulsed columns with sieve plates, reciprocating plate columns, and columns with internal turbine mixers), especially designed or prepared for uranium enrichment using the chemical exchange process. For corrosion resistance to concentrated hydrochloric acid solutions, these columns and their internals are made of or protected by suitable plastic materials (such as fluorocarbon polymers) or glass. The stage residence time of the columns is designed to be short (30 s or less).
   b. Liquid-liquid centrifugal contactors (chemical exchange)
   Liquid-liquid centrifugal contactors especially designed or prepared for uranium enrichment using the chemical exchange process. Such contactors use rotation to achieve dispersion of the organic and aqueous streams and then centrifugal force to separate the phases. For corrosion resistance to concentrated hydrochloric acid solutions, the contactors are made of or are lined with suitable plastic materials (such as fluorocarbon polymers) or are lined with glass. The stage residence time of the centrifugal contactors is designed to be short (30 s or less).
   c. Uranium reduction systems and equipment (chemical exchange)
   1. especially designed or prepared electrochemical reduction cells to reduce uranium from one valence state to another for uranium enrichment using the chemical exchange process. The cell materials in contact with process solutions must be corrosion resistant to concentrated hydrochloric acid solutions; **and**
   2. especially designed or prepared systems at the product end of the cascade for taking the U^{+4} out of the organic stream, adjusting the acid concentration and feeding to the electrochemical reduction cells.
   d. Feed preparation systems (chemical exchange)
   Especially designed or prepared systems for producing high-purity uranium chloride feed solutions for chemical exchange uranium isotope separation plants.
   e. Uranium oxidation systems (chemical exchange)
   Especially designed or prepared systems for oxidation of U^{+3} to U^{+4} for return to the uranium isotope separation cascade in the chemical exchange enrichment process.
   f. Fast-reacting ion exchange resins/adsorbents (ion exchange)
   Fast-reacting ion-exchange resins or adsorbents especially designed or prepared for uranium enrichment using the ion exchange process, including porous macroreticular resins, and pellicular structures in which the active chemical exchange groups are limited to a coating on the surface of an inactive porous support structure, and other composite structures in any suitable form including particles or fibres. These ion exchange resins/adsorbents have diameters of 0.2 mm or less and must be chemically resistant to concentrated hydrochloric acid solutions as well as physically strong enough so as not to degrade in the exchange columns. The resins/adsorbents are especially designed to achieve very fast uranium isotope exchange kinetics (exchange rate half-time of less than 10 s) and are capable of operating at a temperature in the range of 100°C to 200°C.
   g. Ion exchange columns (ion exchange)
   Cylindrical columns greater than 1,000 mm in diameter for containing and supporting packed beds of ion exchange resin/absorbent, especially designed or prepared for uranium enrichment using the ion exchange process. These columns are made of or protected by materials (such as titanium or fluorocarbon plastics) resistant to corrosion by concentrated hydrochloric acid solutions and are capable of operating at a temperature in the range 100°C to 200°C and pressures above 0.7 MPa (102 psi).
   h. Ion exchange reflux systems (ion exchange)
   1. especially designed or prepared chemical or electrochemical reduction systems for regeneration of the chemical reducing agent(s) used in ion exchange uranium enrichment cascades; **and**
   2. especially designed or prepared chemical or electrochemical oxidation systems for regeneration of the chemical oxidizing agent(s) used in ion exchange uranium enrichment cascades.

7. Especially designed or prepared systems, equipment and components for use in laser-based enrichment plants, including:
   a. Uranium vaporization systems (AVLIS)
   Especially designed or prepared uranium vaporization systems which contain high-power strip or scanning electron beam guns with a delivered power on the target of more than 2.5 kW/cm.
   b. Liquid uranium metal handling systems (AVLIS)
   Especially designed or prepared liquid metal handling systems for molten uranium or uranium alloys, consisting of crucibles and cooling equipment for the crucibles.
   c. Uranium metal product and tails collector assemblies (AVLIS)
   Especially designed or prepared product and tails collector assemblies for uranium metal in liquid or solid form.
   d. Separator module housings (AVLIS)
   Especially designed or prepared cylindrical or rectangular vessels for containing the uranium metal vapor source, the electron beam gun, and the product and tails collectors.
   e. Supersonic expansion nozzles (MLIS)
   Especially designed or prepared supersonic expansion nozzles for cooling mixtures of UF_6 and carrier gas to 150 K or less and which are corrosion resistant to UF_6.
   f. Uranium pentafluoride product collectors (MLIS)
   Especially designed or prepared uranium pentafluoride (UF_5) solid product collectors consisting of filter, impact, or cyclone-type collectors, or combinations thereof, and which are corrosion resistant to the UF_5/UF_6 enviroment.

3105.7. con't.

g. UF_6 /carrier gas compressors (MLIS)
Especially designed or prepared compressors for UF_6/carrier gas mixtures, designed for long term operation in a UF_6 environment. The components of these compressors that come into contact with process gas are made of or protected by materials resistant to corrosion by UF_6.

h. Rotary shaft seals (MLIS)
Especially designed or prepared rotary shaft seals, with seal feed and seal exhaust connections, for sealing the shaft connecting the compressor rotor with the driver motor so as to ensure a reliable seal against out-leakage of process gas or in-leakage of air or seal gas into the inner chamber of the compressor which is filled with a UF_6/carrier gas mixture.

i. Fluorination systems (MLIS)
Especially designed or prepared systems for fluorinating UF_5 (solid) to UF_6 (gas).

j. UF_6 mass spectrometers/ion sources (MLIS)
Especially designed or prepared magnetic or quadrupole mass spectrometers capable of taking on-line samples of feed, product or tails, from UF_6 gas streams and having all of the following characteristics:
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; **and**
4. collector system suitable for isotopic analysis.

k. Feed systems/product and tails withdrawal systems (MLIS)
Especially designed or prepared process systems or equipment for enrichment plants made of or protected by materials resistant to corrosion by UF_6, including:
1. feed autoclaves, ovens, or systems used for passing UF_6 to the enrichment process;
2. desublimers (or cold traps) used to remove UF_6 from the enrichment process for subsequent transfer upon heating;
3. solidification or liquefaction stations used to remove UF_6 from the enrichment process by compressing and converting UF_6 to a liquid or solid form; **and**
4. product or tails stations used for transferring UF_6 into containers.

l. UF_6 /carrier gas separation systems (MLIS)
Especially designed or prepared process systems for separating UF_6 from carrier gas. The carrier gas may be nitrogen, argon, or other gas.

m. Laser systems (AVLIS, MLIS and CRISLA)
Lasers or laser systems especially designed or prepared for the separation of uranium isotopes.

8. Especially designed or prepared systems, equipment and components for use in plasma separation enrichment plants, including:

a. Microwave power sources and antennae
Especially designed or prepared microwave power sources and antennae for producing or accelerating ions and having the following characteristics: greater than 30 GHz frequency and greater than 50 kW mean power output for ion production.

b. Ion excitation coils
Especially designed or prepared radio frequency ion excitation coils for frequencies of more than 100 kHz and capable of handling more than 40 kW mean power.

c. Uranium plasma generation systems
Especially designed or prepared systems for the generation of uranium plasma, which may contain high-power strip or scanning electron beam guns with a delivered power on the target of more than 2.5 kW/cm.

d. Liquid uranium metal handling systems
Especially designed or prepared liquid metal handling systems for molten uranium or uranium alloys, consisting of crucibles and cooling equipment for the crucibles.

e. Uranium metal product and tails collector assemblies
Especially designed or prepared product and tails collector assemblies for uranium metal in solid form. These collector assemblies are made of or protected by materials resistant to the heat and corrosion of uranium metal vapour, such as yttria-coated graphite or tantalum.

f. Separator module housings
Cylindrical vessels especially designed or prepared for use in plasma separation enrichment plants for containing the uranium plasma source, radio-frequency drive coil and the product and tails collectors.

9. Especially designed or prepared systems, equipment and components for use in electromagnetic enrichment plants including:

a. Electromagnetic isotope separators
Electromagnetic isotope separators especially designed or prepared for the separation of uranium isotopes, and equipment and components therefore, including:
1. ion sources:
especially designed or prepared single or multiple uranium ion sources consisting of a vapour source, ioniser, and beam accelerator, constructed of suitable materials such as graphite, stainless steel, or copper, and capable of providing a total ion beam current of 50 mA or greater;
2. ion collectors:
collector plates consisting of two or more slits and pockets especially designed or prepared for collection of enriched and depleted uranium ion beams and constructed of suitable materials such as graphite or stainless steel;
3. vacuum housings:
especially designed or prepared vacuum housings for uranium electromagnetic separators, constructed of suitable non-magnetic materials such as stainless steel and designed for operation at pressures of 0.1 Pa or lower; **and**
4. magnet pole pieces:
especially designed or prepared magnet pole pieces having a diameter greater than 2 m used to maintain a constant magnetic field within an electromagnetic isotope separator and to transfer the magnetic field between adjoining separators.

b. High voltage power supplies
Especially designed or prepared high-voltage power supplies for ion sources, having all of the following characteristics: capable of continuous operation, output voltage of 20,000 V or greater, output current of 1 A or greater, and voltage regulation of better than 0.01% over a time period of 8 hours.

c. Magnet power supplies
Especially designed or prepared high-power, direct current magnet power supplies having all of the following characteristics: capable of continuously producing a current output of 500 A or greater at a voltage of 100 V or greater and with a current or voltage regulation better than 0.01% over a period of 8 hours.

3106. Plants for the production or concentration of heavy water, deuterium and deuterium compounds and equipment especially designed or prepared therefore, including:

1. **Water-hydrogen sulphide exchange towers**
   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.
2. **Blowers and compressors**
   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_2S) 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^3/s (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_2S service.
3. **Ammonia-hydrogen exchange towers**
   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 (2,225 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.
4. **Tower internals and stage pumps**
   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 contactors 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.
5. **Ammonia crackers**
   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.
6. **Infrared Absorption Analyzers**
   Infrared absorption analyzers capable of on-line hydrogen/deuterium ratio analysis where deuterium concentrations are equal to or greater than 90%.
7. **Catalytic burners**
   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.
8. **Complete heavy water upgrade systems, or columns therefore**
   Complete heavy water upgrade systems, or columns therefore, especially designed or prepared for the upgrade of heavy water to reactor-grade deuterium concentration.

3107. Plants for the conversion of uranium and plutonium for use in the fabrication of fuel elements and the separation of uranium isotopes as defined in item 3004 and 3005 respectively and equipment especially designed and prepared therfor.

3107.1. Plants for the conversion of uranium and equipment especially designed or prepared therefore, including:

1. Especially designed or prepared systems for the conversion of uranium ore concentrates to UO_3.
2. Especially designed or prepared systems for the conversion of UO_3 to UF_6.
3. Especially designed or prepare systems for the conversion of UO_3 to UO_2.
4. Especially designed or prepared systems for the conversion of UO_2 to UF_4.
5. Especially designed or prepared systems for the conversion of UF_4 to UF_6.
6. Especially designed or prepared systems for the conversion of UF_4 to U metal.
7. Especially designed or prepared systems for the conversion of UF_6 to UO_2.
8. Especially designed or prepared systems for the conversion of UF_6 to UF_4.
9. Especially designed or prepare systems for the conversion of UO_2.to UCl_4

3107.2. Plants for the conversion of plutonium and equipment especially designed or prepared therefore

1. **Plutonium nitrate to oxide conversion systems**
   Complete systems especially designed or prepared for the conversion of plutonium nitrate to plutonium oxide, in particular adapted so as to avoid criticality and radiation effects and to minimise toxicity hazards.
2. **Plutonium oxide to metal production system**
   Complete systems especially designed or prepared for the production of plutonium metal, in particular adapted so as to avoid criticality and radiation effects and to minimise toxicity hazards.

3108. Parts for controlled nuclear equipment included in items 3101 to 3107.

3110. Controlled Nuclear Information

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 Group 3, 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).

Group 4 - Nuclear-Related Dual-Use List

4501. Nuclear related dual-use substances

1. Alpha-emitting radionuclides having an alpha half-life of 10 days or greater but less than 200 years, compounds or mixtures containing any of these radionuclides with a total alpha activity of 1 Ci/kg (37 GBq/kg) or greater, and products or devices containing any of the foregoing, except a product or device containing less than 3.7 GBq (100 mCi) of alpha activity.
2. Aluminum alloys capable of an ultimate tensile strength of 460 MPa (0.46 x 109N/m^2) or more at 293 K (20°C), in the form of tubes or cylindrical solid forms (including forgings) with an outside diameter of more than 75 mm (3 in.).
   Note:
   The phrase "capable of" encompasses aluminum alloys before or after heat treatment.

3. Beryllium metal, alloys containing more than 50% beryllium by weight, beryllium compounds, and manufactures thereof, except:
   a. metal windows for X-ray machines, or for bore-hole logging devices;
   b. oxide shapes in fabricated or semi-fabricated forms specially designed for electronic component parts or as substrates for electronic circuits; **and**
   c. beryl (silicate of beryllium and aluminum) in the form of emeralds or aquamarines.
   Note:
   Item 4501.3. includes waste and scrap containing beryllium as defined above.

4. High-purity (99.99% or greater) bismuth with very low silver content (less than 10 ppm).
5. Boron and boron compounds, mixtures, and loaded materials in which the boron-10 isotope is more than 20% by weight of the total boron content.
6. Calcium (high purity) containing both less than 1,000 ppm by weight of metallic impurities other than magnesium and less than 10 ppm of boron.
7. Chlorine trifluoride (ClF_3).
8. Crucibles made of materials resistant to liquid actinide metals, as follows:
   a. crucibles with a volume of between 150 ml and 8 L and made of or coated with any of the following materials having a purity of 98% or greater:
      1. calcium fluoride (CaF_2);
      2. calcium zirconate (metazirconate) (Ca_2ZrO_3);
      3. cerium sulfide (Ce_2S_3);
      4. erbium oxide (erbia) (Er_2O_3);
      5. hafnium oxide (hafnia) (HfO_2);
      6. magnesium oxide (MgO);
      7. nitrided niobium-titanium-tungsten alloy (approximately 50%Nb, 30%Ti, 20%W);
      8. yttrium oxide (yttria) (Y_2O_3);
      9. zirconium oxide (zirconia) (ZrO_2);
   b. crucibles with a volume of between 50 ml and 2 L and made of or lined with tantalum, having a purity of 99.9% or greater; **and**
   c. crucibles with a volume of between 50 ml and 2 L 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).
9. Fibrous or filamentary materials, prepregs and composite structures, as follows:
   a. carbon or aramid fibrous or filamentary materials having a specific modulus of 12.7 x 10^6 m or greater or a specific tensile strength of 23.5 x 10^4 m or greater, except aramid fibrous or filamentary materials having 0.25% or more by weight of an ester based fibre surface modifier;
   b. glass fibrous or filamentary materials having a specific modulus of 3.18 x 10^6 m or greater and a specific tensile strength of 7.62 x 10^4 m or greater;
   c. thermoset resin impregnated continuous yarns, rovings, tows or tapes with a width no greater than 15 mm (prepregs), made from carbon or glass fibrous or filamentary materials specified in paragraph a or b.; **and**
      Note:
      The resin forms the matrix of the composite.

   d. composite structures in the form of tubes with an inside diameter of between 75 mm (3 in.) and 400 mm (16 in.) made with any of the fibrous or filamentary materials specified in paragraph a or carbon prepreg materials specified in paragraph c.
      Note:
      For the purpose of this paragraph,
      a. "fibrous or filamentary materials" means continuous monofilaments, yarns, rovings, tows or tapes;
      *b. " specific modulus" is the Young's modulus in N/m^2 divided by the specific weight in N/m^3 when measured at a temperature of 23 ± 2° C and a relative humidity of 50 ± 5%; **and***
      c. "specific tensile strength" is the ultimate tensile strength in N/m2 divided by the specific weight in N/m^3 when measured at a temperature of 23 ± 2° C and a relative humidity of 50 ± 5%.

10. Hafnium metal, alloys, and compounds of hafnium containing more than 60% hafnium by weight and manufactures thereof.
11. Helium-3 or helium isotopically enriched in the helium-3 isotope, mixtures containing helium-3, and products or devices containing any of the foregoing, except a product or device containing less than 1 g of helium-3.
12. Lithium enriched in the lithium-6 isotope (6Li) to greater than 7.5 atom percent, alloys, compounds or mixtures containing lithium enriched in the lithium-6 isotope, and products or devices containing any of the foregoing, except thermoluminescent dosimeters.
    Note:
    The natural occurence of the 6 isotope in lithium is 7.5 atom percent.

13. Magnesium (high purity) containing both less than 200 ppm by weight of metallic impurities other than calcium and less than 10 ppm of boron.
14. Maraging steel capable of an ultimate tensile strength of 2,050 MPa (2.050 x 10^9N/m^2) (300,000 lbs./sq.in.) or more at 293 K (20°C), except forms in which no linear dimension exceeds 75 mm.
    Note:
    The phrase "capable of" encompasses maraging steel before or after heat treatment.

4501. con't.

15. Nickel powder and porous nickel metal, as follows:
    a. powder with a nickel purity content of 99.0% or greater and a mean particle size of less than 10 μm measured by the ASTM B 330 standard, except filamentary nickel powders;
    Note:
    Nickel powders which are especially prepared for the manufacture of gaseous diffusion barriers are controlled by Item 3105.3.a.2.

    b. porous nickel metal produced from materials referred to in paragraph a, except single porous nickel metal sheets not exceeding 1,000 cm^2 per sheet.
    Note:
    4501.15.b. refers to porous metal formed by compacting and sintering the material in item 4501.15.a. to form a metal material with fine pores interconnected throughout the structure.

16. Radium-226, radium-226 compounds, or mixtures containing radium-226, and products or devices containing any of the foregoing, except medical applicators and a product or device containing not more than 0.37 GBq (10 mCi) of radium-226 in any form.
17. Titanium alloys capable of an ultimate tensile strength of 900 MPa (0.9 x $10^9 N/m^2$) (130,500 lbs./sq.in.) or more at 293 K (20°C) in the form of tubes or cylindrical solid forms (including forgings) with an outside diameter of more than 75 mm (3 in.)
    Note:
    The phrase "capable of" encompasses titanium alloys before or after heat treatment.

18. Tungsten, as follows: parts made of tungsten, tungsten carbide, or tungsten alloys (greater than 90% tungsten) 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.
19. Zirconium with a hafnium content of less than 1 part hafnium to 500 parts zirconium by weight, in the form of metal, alloys containing more than 50% zirconium by weight, and compounds and manufactures wholly thereof; except zirconium in the form of foil having a thickness not exceeding 0.10 mm (0.004 in.).
    Note:
    4501.19. includes waste and scrap containing zirconium as defined above.

4502. Industrial equipment

1. Flow-forming machines and spin-forming machines capable of flow-forming functions, and mandrels, as follows, and specially designed software therefore:
    a. having three or more rollers (active or guiding) and, according to the manufacturer's technical specification, can be equipped with numerical control units or a computer control; **and**
    b. rotor-forming mandrels designed to form cylindrical rotors of inside diameter between 75 mm (3 in.) and 400 mm (16 in.).
    Note:
    4502.1. includes machines which have only a single roller designed to deform metal plus two auxiliary rollers which support the mandrel, but do not participate directly in the deformation process.

2. Numerical control units, numerical controlled machine tools, and specially designed software as follows:
    a. for numerical control units controlled by its associated software, see item 4502.2.c.2.;
    b. 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, that have positioning accuracies with all compensations available less (better) than 0.006 mm along any linear axis (overall positioning) for machines capable of machining diameters greater than 35 mm;
        Note:
        Bar machines (Swissturn), limited to machining only bar feed thru, are excluded if maximum bar diameter is equal to or less than 42 mm and there is no capability of mounting chucks. Machines may have drilling and/or milling capabilities for machining parts with diameters less than 42 mm.

        2. machine tools for milling, having any of the following characteristics:
            a. positioning accuracies with all compensations available are less (better) than 0.006 mm along any linear axis (overall positioning); **or**
            b. two or more contouring rotary axes;
            Note:
            This does not include milling machines having the following characteristics:
            *a. x-axis travel greater than 2 m; **and***
            b. overall positioning accuracy on the x-axis more (worse) than 0.030 mm.

        3. machine tools for grinding, having any of the following characteristics:
            a. positioning accuracies with all compensations available are less (better) than 0.004 mm along any linear axis (overall positioning); **or**
            b. having two or more contouring rotary axes; **and**
            Note:
            The following grinding machines are excluded:
            a. cylindrical external, internal, and external-internal grinding machines having all the following characteristics:
                1. limited to cylindrical grinding;
                2. a maximum workpiece outside diameter or length of 150 mm;
                *3. not more than two axes that can be coordinated simultaneously for contouring control; **and***
                4. no contouring c axis;
            b. jig grinders with axes limited to x, y, c, and a, where c axis is used to maintain the grinding wheel normal to the work surface, and the a axis is configured to grind barrel cams;
            *c. tool or cutter grinding machines with software specially designed for the production of tools or cutters; **and***
            d. crankshaft or camshaft grinding machines.

        4. non-wire type electrical discharge machines (EDM) that have two or more contouring rotary axes and that can be coordinated simultaneously for contouring control; **and**

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

Technical Notes:
1. *Axis nomenclature shall be in accordance with International Standard ISO 841, "Numerical Control Machines - Axis and Motion Nomenclature".*
2. *Not counted in the total number of contouring rotary axes are secondary parallel contouring rotary axes the centre line of which is parallel to the primary rotary axis.*

4502.b.notes. con't.

3. 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.

c. software:
   1. software specially designed or modified for the development, production, or use of equipment referred to in paragraph a orb.; **and**
   2. for any combination of electronic devices or system enabling such device(s) to function as a numerical control unit capable of controlling 5 or more interpolating axes that can be coordinated simultaneously for contouring control.

Note 1:
Software is controlled whether exported separately or residing in a numerical control unit or any electronic device or system.
Note 2:
Software specially designed or modified by the manufacturers of the control unit or machine tool to operate an uncontrolled machine tool is not controlled.

3. Dimensional inspection machines, devices, or systems, as follows, and specially designed software therefore:
   a. computer controlled or numerically controlled dimensional inspection machines having both of the following characteristics:
      1. 2 or more axes; **and**
      2. a one-dimensional length measurement uncertainty equal to or less (better) than (1.25 + L/1000) µm tested with a probe of an accuracy of less (better) than 0.2 µm (L is the measured length in mm) (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 µm within a measuring range up to 0.2 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 mm; **and**
            2. drift equal to or less (better) than 0.1%/d at a standard ambient test room temperature of ± 1 K; **or**
         c) measuring systems that have both of the following characteristics:
            1. contain a laser; **and**
            2. maintain for at least 12 hrs., over a temperature range of ± 1 K around a standard temperature and a standard pressure:
               a. a resolution over their full scale of 0.1 µm or better; **and**
               b. with a measurement uncertainty equal to or less (better) than (0.2 + L/2000) µm (L is the measured length in mm), 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; **and**
      2. angular measuring instruments having an angular position deviation equal to or less (better) than 0.00025°; **and**

Note:
4502.3.b.2. does not include 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 µm per 5 mm; **and**
      2. angular position deviation equal to or less than 0.02°.

Note:
Specially designed software for these systems include software for simultaneous measurements of wall thickness and contour.
Technical Notes:
1. Machine tools that can be used as measuring machines are controlled if they meet or exceed the criteria specified for the machine tool function or the measuring tool function.
2. A machine described in 4502.3. is controlled 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°C and having induction coils 600 mm (24 in.) or less in diameter, and designed for power inputs of 5 kW or more; and power supplies specially designed therefore with a specified power output of 5 kW or more.

Note:
4502.4. does not include furnaces designed for the processing of semiconductor wafers.

5. Isostatic presses capable of achieving a maximum working pressure of 69 MPa or greater having a chamber cavity with an inside diameter in excess of 152 mm and specially designed dies, molds, controls or specially designed software therefore.

Note:
The term "isostatic presses" means 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.
Technical Note:
The inside chamber dimension is that of the chamber in which both the working temperature and the working pressure are acheived 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.

6. Robots or end-effectors having either of the following characteristics; and specially designed software or specially designed controllers therefore:
   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 x 10^4 Gy (Silicon) [5 x 10^6 rad (Silicon)] without operational degradation.

Notes:
1. "Robot" means a manipulation mechanism, which may be of the continuous path or of the point-to-point variety, may use sensors, and has all of 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***

4502.6.notes. con't.

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.

'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 pattern. 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; **or***

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.

2. "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.

3. The definition in paragraph 1.a. does not include robots specially designed for non-nuclear industrial applications such as automobile paint-spraying booths.

7. Vibration test systems, equipment, components and software therefore, as follows:
   a. electrodynamic vibration test systems, employing feedback or closed loop control techniques and incorporating a digital controller, capable of vibrating at 10 g RMS or more between 20 Hz and 2,000 Hz and imparting forces of 50 kN (11,250 lbs.) measured bare table, or greater;
   b. digital controllers, combined with specially designed software for vibration testing, with a real-time bandwidth greater than 5 kHz and being designed for use with the systems referred to in 4502.7.a.;
   c. vibration thrusters (shaker units), with or without associated amplifiers, capable of imparting a force of 50 kN (11,250 lbs.), measured bare table, or greater, which are usable for the systems referred to in 4502.7.a.;
   d. 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 50 kN, measured bare table, or greater, which are usable for the systems referred to in 4502.7.a.; **and**
   e. specially designed software for use with the systems referred to in 4502.7.a. or for the electronic units referred to in 4502.7.d.
8. Vacuum and controlled atmosphere metallurgical melting and casting furnaces as follows, and specially configured computer control and monitoring systems and specially designed software therefore:
   a. arc remelt and casting furnaces with consumable electrode capacities between 1,000 cm^3 and 20,000 cm^3 and capable of operating with melting temperatures above 1,700°C; **and**
   b. electron beam melting and plasma atomization and melting furnaces with a power of 50 kW or greater and capable of operating with melting temperatures above 1,200°C.

4503. Uranium isotope separation equipment and components (other than items listed in Group 3, Item 3105.)

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); **and**
   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 kg to 23 kg (2 lb. to 50 lb.); **and**
      3. capable of balancing speed of revolution more than 5,000 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 kg to 23 kg (2 lb. 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 therefore.
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 therefore, precision mandrels; and specially designed software therefore.
5. Frequency changers (also known as converters or inverters) or generators having all of the following characteristics:

4502.b.notes. con't.

a. a multiphase output capable of providing a power of 40 W or more;
b. capable of operating in the frequency range between 600 Hz and 2,000 Hz;
c. total harmonic distortion below 10%; **and**
d. frequency control better than 0.1%; *except* such frequency changers specially designed or prepared to supply motor stators and having the characteristics listed in 4503.5.b. and d., 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 Hz to 2000 Hz and a power range of 50 VA to 1000 VA. The stators consist of multiphase windings on a laminated low-loss iron core comprising thin layers typically 2.0 mm (0.008 in.) thick or less.

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 1,000 nm and 1,100 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; **or**
         b. a multiple-transverse mode output having an average output power exceeding 50 W; **or**
      2. operating at a wavelength between 1,000 nm and 1,100 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 9,000 nm and 11,000 nm;

      N.B.:
      4503.6.g. does not include higher power (typically 1 kW to 5 kW) industrial C02 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 nm and 360 nm; **and**
   i. para-hydrogen Raman shifters designed to operate at 16 μm 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 4502.2. and 4502.3. 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 therefore 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_6;
   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_6; **and**
   f. mass spectrometers equipped with a microfluorination ion source designed for use with actinides or actinide fluorides; except specially designed or prepared magnetic or quadruple mass spectrometers capable of taking on-line samples of feed, product or tails from UF_6 gas streams and having all of the following characteristics:
      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; **and**
      4. having a collector system suitable for isotopic analysis.
8. Pressure transducers which are capable of measuring absolute pressure at any point in the range 0 kPa to 13 kPa, with pressure sensing elements made of or protected by nickel, nickel alloys with more than 60% nickel by weight, aluminum or aluminum alloys as follows:
   a. transducers with a full scale of less than 13 kPa and an accuracy of better than ±1% of full scale; **and**
   b. transducers with a full scale of 13 kPa or greater and an accuracy of better than ±130 Pa.

Note:
For the purposes of this paragraph,
a. pressure transducers are devices that convert pressure measurements into an electrical signal.
b. "accuracy" includes non-linearity, hysteresis and repeatability at ambient temperature.

9. Valves 5 mm (0.2 in.) or greater in nominal size, 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.

Note:
For valves with different inlet and outlet diameters, the nominal size parameter above refers to the smallest diameter.

10. Superconducting solenoidal electromagnets with all of the following characteristics:
    a. capable of creating magnetic fields or more than 2 T (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**

4503.10. con't.

d. with a magnetic field uniform to better than 1% over the central 50% of the inner volume.

Note:

Item 4503.10. does not cover magnets specially designed for and exported as parts of medical nuclear magnetic resonance (NMR) imaging systems. It is understood that the wording 'As part of' does not prohibit separate shipments from different sources provided the related export documents clearly specify the 'part' of the relationship.

11. Vacuum pumps with an input throat size of 38 cm (15 in.) or greater with a pumping speed of 15,000 L/s or greater and capable of producing an ultimate vacuum better than 10^{-4} torrs (1.33×10^{-4} mbar).

Notes:

1. *The ultimate vacuum is determined at the input of the pump with the input of the pump blocked off.*
2. *The pumping speed is determined at the measurement point with nitrogen gas or air.*

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. *4503.14. includes 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. *4503.14. 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

(other than items listed in Group 3, Item 3106.)

1. Specialised packings for use in separating heavy water from ordinary water, made of phosphor bronze mesh (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 (KNH2 / NH3), 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 Mpa to 60 MPa (15 to 600 atmospheres); for dilute potassium amide solutions (less than 1%), operating pressure of 20 Mpa to 60 Mpa (200 to 600 atmospheres); **and**
   c. a capacity greater than 8.5 m^3/h (5 cubic feet per minute).
3. Water-hydrogen sulfide exchange tray columns constructed from fine carbon steel with a diameter of 1.8 m or greater, which can operate at a nominal pressure of 2 MPa (300 psi) or greater, and internal contactors therefore.

Notes:

1. *Internal contactors of the columns are segmented trays which have an effective assembled diameter of 1.8 m or greater, are designed to facilitate countercurrent contacting and are constructed of materials resistant to corrosion by hydrogen sulfide/water mixtures. These may be sieve trays, valve trays, bubble cap trays or turbogrid trays.*
2. *Fine carbon steel in this paragraph is defined to be steel with the austenitic ASTM (or equivalent standard) grain size number of 5 or greater.*
3. *Materials resistant to corrosion by hydrogen sulfide/water mixtures in 4504.3. are defined to be stainless steels with a carbon content of 0.03% or less.*

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 MPa 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 H2-compatible materials; **and**
   d. with internal diameters of 1 m or greater and effective lengths of 5 m or greater.

Note:

Fine-grain stainless steels in 4504.4. are defined to be fine-grain austenitic stainless steels with an ASTM (or equivalent standard) grain size number of 5 or greater.

5. Ammonia synthesis converters or synthesis units in which the synthesis gas (nitrogen and hydrogen) is withdrawn from an ammonia/hydrogen high-pressure exchange column and the synthesised ammonia is returned to said column.
6. Turboexpanders or turboexpander-compressor sets designed for operation below 35 K and a throughput of hydrogen gas of 1,000 kg/hr or greater.

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 ($Q = \int i dt$), 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).]

Notes:

1. *"Time duration of the beam pulse" means,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.*

4505.1. notes con't.

2. "Peak beam current" means, 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/s or greater.
3. Mechanical rotating mirror cameras, as follows, and specially designed components therefore:
   a. framing cameras with recording rates greater than 225,000 frames per second; **and**
   b. streak cameras with writing speeds greater than 0.5 mm/μs.

   Note:
   Components of such cameras include synchronizing electronics units and 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 therefore;
   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 paragraph b. 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 4505.4.b.
      5. Specialised instrumentation for hydrodynamic experiments as follows:
         a. velocity interferometers for measuring velocities in excess of 1 km/s during time intervals less than 10 μs (VISARSs, Doppler laser interferometers, DLIs, etc.);
         b. manganin gauges for pressures greater than 100 kilobars; **and**
         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); **and**
   b. Arrangements using single or multiple detonators designed to nearly simultaneously initiate an explosive surface (over [greater] than 5,000 mm^2) 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 utilise a small electrical conductor (bridge, bridge wire, or foil) that explosively vaporises when a fast, high current electrical pulse is passed through it. In nonslapper types, the exploding conductor starts a chemical detonation in a contacting high-explosive material such as PETN (penta-erythritoltetranitrate). 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 sprytron 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 2,500 V or more;
         b. anode peak current rating of 100 A or more; **and**
         c) anode delay time of 10 μs or less;
      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; and
      3. modules or assemblies with a fast switching function having all of the following characteristics:
         a. anode peak voltage rating greater than 2,000 V;
         b. anode peak current rating of 500 A or more; **and**
         c) turn-on time of 1 μs or less; **and**
   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 in 4506.1.; **and**
   b. modular electrical pulse generators (pulsers) designed for portable, mobile, or ruggedised-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);
      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^3 and having a detonation velocity greater than 8,000 m/s; **or**
   e. Hexanitrostilbene (HNS).

4507. Nuclear testing equipment and components

1. Photomultiplier tubes with a photocathode area of greater than 20 cm^2 having an anode pulse rise time of less than 1 ns.
2. 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 equipment

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 can be used to provide remote actions in radiochemical separation operations and hot cells, as follows:
      1. having a capability of penetrating 0.6 m or more of hot cell wall (through-the-wall operation); **or**
      2. having a capability of bridging over the top of a hot cell wall with a thickness of 0.6 m or more (over-the-wall operation);

      Note:
      Remote manipulators provide translation of human operator actions to a remote operating arm and terminal fixture. They may be of a master/slave type or operated by joystick or keypad.

   b. high-density (lead glass or other) radiation shielding windows greater than 0.09 m^2 on cold area and with a density greater than 3 g/cm^3 and a thickness of 100 mm or greater and specially designed frames therefore; **and**
   c. radiation-hardened TV cameras, or lenses therefore, specially designed or rated as radiation hardened to with-stand greater than 5 X 10^4 Gy (Silicon) (5 X 10^6 rad (Silicon)) without operational degradation.

3. Tritium facilities, plants and equipment, as follows:
   a. facilities or plants for the production, recovery, extraction, concentration or handling of tritium, tritium compounds or mixtures; **and**
   b. equipment for tritium facilities or plants, as follows:
      1. hydrogen or helium refrigeration units capable of cooling to 23 K (-250°C) or less, with heat removal capacity greater than 150 W; **and**
      2. hydrogen isotope storage and purification systems using metal hydrides as the storage or purification medium.
4. Platinised 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.
5. Lithium isotope separation facilities, plants and equipment, as follows:
   a. facilities or plants for the separation of lithium isotopes; **and**
   b. equipment for the separation of lithium isotopes, as follows:
      1. packed liquid-liquid exchange columns specially designed for lithium amalgams;
      2. mercury and/or lithium amalgam pumps;
      3. lithium amalgam electrolysis cells;
      4. evaporators for concentrated lithium hydroxide solution.

4510. Controlled nuclear information

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 Group 4, 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).

Definitions of Terms used in Groups 3 and 4

"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.")

"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).

"Development"

Is related to all stages prior to "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.

"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.

"Isostatic Presses"

Is defined as 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.

"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 equalise and minimise the maximum deviations.

"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.

"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).

"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 ±10% of nominal rated voltage;
      b. Frequency variation shall not be greater than ±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 stages, such as: construction, product 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.

"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."

"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 required for the "development", "production", or "use", of any item contained in the List. The information takes the form of "technical data" or "technical assistance".

"Use"

Operation, installation (including on-site installation), maintenance (checking), repair, overhaul and refurbishing.

"User-accessible programmability"

The facility allowing a user to insert, modify of 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

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)

5104. Softwood Lumber Products

1. The definition in this subsection applies in this item.
   "province of first manufacture" means the province where the mill at which a softwood lumber product was first manufactured into such a product is situated, whether or not that product is further processed (for example, by planing or kiln-drying) or is transformed from one softwood lumber product into another such product (for example, a re-manufactured product) in another province. (province de première transformation)
2. Softwood lumber products, as follows:
   a. coniferous wood sawn or chipped lengthwise, sliced or peeled, whether or not planed, sanded or finger-jointed, of a thickness exceeding 6 mm, that is classified under subheading 4407.10.00 of the Harmonised Tariff Schedule of the United States (1996) (United States International Trade Commission Pub. 2937, 19 U.S.C. 1202 (1988)) and in respect of which the province of first manufacture is the Province of Ontario, the Province of Quebec, the Province of British Columbia or the Province of Alberta; (United States) **and**
   b. coniferous wood (including strips and friezes for parquet flooring, not assembled), continuously shaped (tongued, grooved, rebated, chamfered, V-jointed, beaded, moulded, rounded or the like) along any of its edges or faces (other than wood mouldings and wood dowel rods), whether or not planed, sanded or finger-jointed, that is classified under subheading 4409.10.10, 4409.10.20 or 4409.10.90 of the Harmonised Tariff Schedule of the United States (1996) (United States International Trade Commission Pub. 2937, 19 U.S.C. 1202 (1988)) and in respect of which the province of first manufacture is the Province of Ontario, the Province of Quebec, the Province of British Columbia or the Province of Alberta. (United States)
3. This item ceases to be in force on March 31, 2001.

5105. Softwood Lumber Products

1. Softwood lumber products, as follows:
   a. coniferous wood sawn or chipped lengthwise, sliced or peeled, whether or not planed, sanded or finger-jointed, of a thickness exceeding 6 mm, that isclassified under subheading 4407.10.00 of the Harmonised Tariff Schedule of the United States 2001. (United States International Trade Commission Pub. 3378, 19 U.S.C. 1202 (1988)); (United States) **and**
   b. coniferous wood (including strips and friezes for parquet flooring, not assembled), continuously shaped (tongued, grooved, rebated, chamfered, V-jointed, beaded, moulded, rounded or the like) along any of its edges or faces (other than wood mouldings and wood dowel rods), whether or not planed, sanded or finger-jointed, that is classified under subheading 4409.10.10, 4409.10.20 or 4409.10.90 of the Harmonised Tariff Schedule of the United States (2001. (United States International Trade Commission Pub. 3378, 19 U.S.C. 1202 (1988)). (United States)

Agriculture and Food Products

5201. Peanut Butter that is classified under tariff item No. 2008.11.10 of Schedule I to the Customs Tariff. (All destinations)

5202. Roe Herring

1. In this item,
   "fishing zones of Canada" has the same meaning as in subsection 41. of the Territorial Sea and Fishing Zones Act; (zone de pêche du Canada)
   "internal waters of Canada" has the same meaning as in subsection 32. of the Territorial Sea and Fishing Zones Act; (eaux intérieures du Canada)
   "territorial sea of Canada" has the same as in susbsection 31. 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)

5203. Sugar-containing Products

Sugar-containing products that are classified under subheadings 1701.91.54, 1704.90.74, 1806.20.75, 1806.20.95, 1806.90.55, 1901.90.56, 2101.12..54, 2101.20.54, 2106.90.78 and 2106.90.95 of *Harmonised Tariff Schedule of the United States (1995)* (United States International Trade Commission Pub. 2831, 19 U.S.C. § 1202 (1988)). *(United States)*

5204. Sugars, Syrups and Molasses

Sugars, Syrups and Molasses that are classified under subheadings 1701.12.10, 1701.91.10, 1701.99.10, 1702.90.10, and 2106.90.44 of *Harmonised Tariff Schedule of the United States (1995)* (United States International Trade Commission Pub. 2831, 19 U.S.C. § 1202 (1988)). *(United States)*

United States Origin Goods

5400. United States Origin Goods

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. Goods in Transit

1. 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,
      1. 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,
      2. cites from a Shipper's Export Declaration, **or**
      3. 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)

Other Military and Strategic Goods

5501. Blinding Laser Weapons.

Laser weapons specifically designed, as their sole combat function or as one of their combat functions, to cause permanent blindness to non-enhanced vision, that is to the naked eye or to the eye with corrective eyesight devices.
(All destinations).

5502. Nuclear Fusion Reactors.

1. Subject to subitem 2., systems, equipment, material, components, software and technology for use in research, development, design, testing, demonstration, or training related to nuclear fusion or the construction and operation of a nuclear fusion reactor, including:
   a. reactor assemblies incorporating toroidal and poloidal field coils;
   b. independent electrical and magnet power supply systems;
   c. high-power microwave radio frequency systems; **and**
   d. feedback, control and data acquisition systems.
   (All destinations)
2. This item does not apply to data:
   a. that is contained in published books or periodicals or that is otherwise available to the public; **or**
   b. that has been made available without restrictions on its further dissemination.

5503. Anti-personnel Mines.

Anti-personnel mines as defined in section 2 of the Anti-Personnel Mines Convention Implementation Act. *(All destinations)*

5504. Strategic Goods

1. In this item the terms "development", "production", "software", "spacecraft", "technology" and "use" have the same meaning as in the "Definitions for Terms in Groups 1 and 2" of the Guide.
2. Strategic goods as follows:
   a. goods controlled by Group 1 of the Guide as follows:
      i. Global navigation satellite systems receiving equipment controlled by item 1071.5 of the Guide, the associated software controlled by item 1074 of the Guide, and the associated technology controlled by item 1075 of the Guide, **and**
      ii. propulsion and space-related equipment controlled by items 1091.4 to 1091.11 of the Guide, the associated software controlled by item 1094 of the Guide, and the associated technology controlled by item 1095 of the Guide;
   b. subject to the General Software note; software that is specially designed or modified for the development or use of the goods controlled by paragraphs d. to i.;
   c. subject to the General Technology note; technology that is specially designed or modified for the development or production of the goods controlled by paragraphs d. to i.;
   d. payloads specially designed or modified for spacecraft, and specially designed components therefore not controlled elsewhere by Group 1 of the Guide;
   e. ground control stations for telemetry and tracking and control of space launch vehicles or spacecraft, and specially designed components therefore;
   f. chemiluminescent compounds specially designed or modified for military use, and specially designed components therefore;
   g. radiation-hardened microelectronic circuits that meet or exceed all of the following, and specially designed components therefore, namely:
      i. a total dose of 5×10^5 Rads (SI),
      ii. a dose rate upset of 5×10^8 Rads (SI)/sec,
      iii. a neutron dose of 1×10^{14} N/cm^2,

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iv. a single event upset of 1 x 10^{-7} or less error/bit/day, **and**
v. single event latch-up free and having a dose rate latch-up of 5 x 10^{8} Rads (SI)/sec or greater;

h. nuclear weapons design and test equipment, namely:
   i. any article, material, equipment or device which is specially designed or modified for use in the design, development or fabrication of nuclear weapons or nuclear explosive devices, (All destinations)
   ii. any article, material, equipment or device which is specially designed or modified for use in the devising, carrying out or evaluating of nuclear weapons tests or other nuclear explosions; (All destinations) **and**

i. any other articles not specifically set out in paragraphs a. to h. or in Group 2 or Group 6 that are United States origin goods, which have been determined under Parts 120 to 130 of Title 22 of the International Traffic in Arms Regulations of the Code of Federal Regulations (United States) as having substantial military applicability, and which have been specially designed or modified for military purposes.

5505. Goods for Certain Uses (Catch-all)

All goods not listed elsewhere in this List

a. that are intended for use in
   i. the development, production, handling, operation, maintenance, storage, detection, identification or dissemination of chemical, biological or nuclear weapons, or of materials or equipment that could be used in such weapons,
   ii. the development, production, handling, operation, maintenance or storage of missiles capable of delivering chemical, biological or nuclear weapons, or of materials or equipment that could be used in such missiles, **or**
   iii. any chemical, biological or nuclear weapons facility or missile facility; **or**

b. in respect of which there are reasonable grounds to suspect that the goods are intended for use in
   i. the development, production, handling, operation, maintenance, storage, detection, identification or dissemination of chemical, biological or nuclear weapons, or of materials or equipment that could be used in such weapons,
   ii. the development, production, handling, operation, maintenance or storage of missiles capable of delivering chemical, biological or nuclear weapons, or of materials or equipment that could be used in such missiles, **or**
   iii. any chemical, biological or nuclear weapons facility or missile facility.

   (All destinations other than Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Poland, Portugal, the Republic of Korea, Romania, the Russian Federation, the Slovak Republic, South Africa, Spain, Sweden, Switzerland, Ukraine, the United Kingdom, and the United States; provided that the final destination of the goods is one of these countries).

Group 6 - Missile Technology Control Regime List

Note:
Terms in "double quotation marks" are defined terms. Refer to "Group 6 - Definitions" on page 103.

General Technology Note
The transfer of "technology" directly associated with any goods controlled in the Annex is controlled according to the provisions in each Item to the extent permitted by national legislation. The approval of any Annex item for export also authorises the export to the same end user of the minimum "technology" required for the installation, operation, maintenance (checking) and repair of the item which are not controlled or whose export has been authorised.

Note:
*Controls do not apply to "technology" "in the public domain", **or** to "basic scientific research" or to the minimum necessary information for patent applications.*

General Software Note
The Annex does not control "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".*

Note:
The General Software Note only applies to general purpose, mass market "software".

Category 6010: Complete Delivery Systems

6011. Equipment, Assemblies and Components

1. Complete rocket systems (including ballistic missile systems, space launch vehicles, and sounding rockets) capable of delivering at least a 500 kg payload to a range of at least 300 km.
2. Complete 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.
   (All Destinations)

6012. Test and Production Equipment

1. "Production facilities" specially designed for the systems specified in 6011.

6013. Materials

None.

6014. Software

1. "Software" specially designed or modified for the "use" of "production facilities" specified in 6012.
2. "Software" which co-ordinates the function of more than one subsystem, specially designed or modified for "use" in systems specified in 6011.

6015. Technology

1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 6011., 6012., or 6014.

Category 6020: Complete Subsystems Usable for Complete Delivery Systems

6021. Equipment, Assemblies and Components

1. Complete subsystems usable in the systems specified in 6011., as follows:
   a. Individual rocket stages usable in the systems specified in 6011.;
   b. Re-entry vehicles, and equipment designed or modified therefore, usable in the systems specified in 6011., 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 re-entry vehicles;
   c. Solid propellant rocket motors or liquid propellant rocket engines, usable in the systems specified in 6011., having a total impulse capacity of 1.1×10^6 Ns (2.5×10^5 lb.s) or greater;
      Note:
      Governments may permit the export of liquid propellant apogee engines specified in 6021.1.c., designed or modified for satellite applications, may be treated as Category II if the subsystem is exported subject to end-use statements and quantity limits appropriate for the excepted end-use stated above, when having all of the following parameters:
      *a. nozzle throat diameter of 20 mm or less, **and***
      b. combustion chamber pressure of 15 bar or less.

   d. Guidance sets´, usable in the systems specified in 6011., capable of achieving system accuracy of 3.33% or less of the range (e.g. a ´CEP´ of 10 km or less at a range of 300 km), except as provided in Note 1 below for those designed for missiles with a range under 300 km or manned aircraft;
      Technical Notes:
      1. *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.*
      2. *´CEP´ (circle of equal probability) is a measure of accuracy, defined as the radius of the circle centred at the target, at a specific range, in which 50% of the payloads impact.*

6021.1. con't.

e. Thrust vector control sub-systems, usable in the systems specified in 6011., except as provided in Note 1 below for those designed for rocket systems that do not exceed the range/payload capability of systems specified in 6011.;

Technical Note:

6021.1.e. includes the following methods of achieving thrust vector control:

a. Flexible nozzle;
b. Fluid or secondary gas injection;
c. Movable engine or nozzle;
d. Deflection of exhaust gas stream (jet vanes or probes);
e. Use of thrust tabs.

f. Weapon or warhead safing, arming, fusing, and firing mechanisms, usable in the systems specified in 6011., except as provided in Note 1 below for those designed for systems other than those specified in 6011.

Note:

1. The exceptions in 6021.1.b., 6021.1.c., 6021.1.d., 6021.1.e. and 6021.1.f. above may be treated as Category II if the subsystem is exported subject to end-use statements and quantity limits appropriate for the excepted end-use stated above.

6022. Test and Production Equipment

1. "Production facilities" specially designed for the subsystems specified in 6021.
   "Production equipment" specially designed for the subsystems specified in 6021.

6023. Materials

None.

6024. Software

1. "Software" specially designed or modified for the "use" of "production facilities" specified in 6022.1.
2. "Software" specially designed or modified for the "use" of rocket motors or engines specified in 6021.1.c.
3. "Software", specially designed or modified for the "use" of 'guidance sets' specified in 6021.1.d.

   Note:

   6024.3. includes "software", specially designed or modified to enhance the performance of 'guidance sets' to achieve or exceed the accuracy specified in 6021.1.d.

4. "Software" specially designed or modified for the "use" of subsystems or equipment specified in 6021.1.b.3.
5. "Software" specially designed or modified for the "use" of systems in 6021.1.e.
6. "Software" specially designed or modified for the "use" of systems in 6021.1.f.

Note:

Subject to end-use statements appropriate for the excepted end-use, "software" controlled by 6024.2 - 6024.6 may be treated as Category II. as follows:

1. Under 6024.2., if specially designed or modified for liquid propellant apogee engines, designed or modified for satellite applications as specified in the Note to 6021.1.c.
2. Under 6024.3., if designed for missiles with a range of under 300 km or manned aircraft.
3. Under 6024.4., if specially designed or modified for re-entry vehicles designed for non-weapon payloads.
4. Under 6024.5., if designed for rocket systems that do not exceed the range payload capability of systems specified in 6011.
5. Under 6024.6., if designed for systems other than those specified in 6011.

6025. Technology

1."Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 6021., 6022. or 6024.

Category 6030: Propulsion Components and Equipment

6031. Equipment, Assemblies and Components

1. Lightweight turbojet and turbofan engines (including turbocompound engines), usable in the systems specified in 6011., that are small and fuel efficient, as follows:
   a. Engines having both of the following characteristics :
      1. Maximum thrust value greater than 400 N (achieved un-installed) excluding civil certified engines with a maximum thrust value greater than 8,890 N (achieved un-installed); **and**
      2. Specific fuel consumption of 0.15 $kgN^{-1}h^{-1}$ or less (at maximum continuous power at sea level static and standard conditions);
   b. Engines designed or modified for systems specified in 6011., regardless of thrust or specific fuel consumption.

   Note:

   Engines specified in 6031.1.a. may be exported as part of a manned aircraft or in quantities appropriate for replacement parts for a manned aircraft.

2. Ramjet/scramjet/pulse jet/combined cycle engines, including devices to regulate combustion, and specially designed components therefore, usable in the systems specified in 6011.
3. Rocket motor cases, ´insulation´ components and nozzles therefore, usable in the systems specified in 6011.

   Technical Note:

   In 6031.3. ´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 components comprising sheet stock containing an insulating or refractory material. It may also be incorporated as stress relief boots or flaps.

   Note:

   Refer to 6033.2. for ´insulation´ material in bulk or sheet form.

4. Staging mechanisms, separation mechanisms, and interstages therefore, usable in the systems specified in 6011.
5. Liquid and slurry propellant (including oxidisers) control systems, and specially designed components therefore, usable in the systems specified in 6011., designed or modified to operate in vibration environments of more than 10 g RMS between 20 Hz and 2 kHz.

   Note 1:

   The only servo valves and pumps specified in 6031.5. are the following:

   a. Servo valves designed for flow rates of 24 litres 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 ms;
   b. Pumps, for liquid propellants, with shaft speeds equal to or greater than 8,000 RPM or with discharge pressures equal to or greater than 7,000 kPa (1,000 psi).

   Note 2:

   Systems and components specified in 6031.5.. may be exported as part of a satellite.

6. Hybrid rocket motors and specially designed components therefore, usable in the systems specified in 6011.

6032. Test and Production Equipment

1. "Production facilities" specially designed for equipment or materials specified in 6031. or 6033.
2. "Production equipment" specially designed for equipment or materials specified in 6031. or 6033.
3. Flow-forming machines, and specially designed components therefore, which:
   a. according to the manufacturers technical specification can be equipped with numerical control units or a computer control, even when not equipped with such units at delivery; **and**
   b. have more than two axes which can be co-ordinated 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.
   Note:
   This item does not include machines that are not usable in the "production" of propulsion components and equipment (e.g., motor cases) for systems specified in 6011.

6033. Materials

1. ´Interior lining´ usable for rocket motor cases in the systems specified in 6011.
   Technical Note:
   In 6033.1. ´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.

2. ´Insulation´ material in bulk form usable for rocket motor cases in the systems specified in 6011.
   Technical Note:
   In 6033.2. ´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 specified in 6031.3.

6034. Software

1. "Software" specially designed or modified for the "use" of "production facilities" and flow forming machines specified in 6032.1. or 6032.3.
2. "Software" specially designed or modified for the "use" of equipment specified in 6031.1., 6031.2., 6031.4., 6031.5. or 6031.6.
   Notes:
   1. *"software" specially designed or modified for the "use" of engines specified in 6031.1. may be exported as part of a manned aircraft or as replacement "software" therefore.*
   2. *"software" specially designed or modified for the "use" of propellant control systems specified in 6031.5 may be exported. as part of a satellite or as replacement "software" therefore.*

3. "Software" specially designed or modified for the "development" of equipment specified in 6031.2., 6031.3. or 6031.4.

6035. Technology

1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment, materials or "software" specified in 6031., 6032., 6033. or 6034.

Category 6040: Propellants and Chemicals

6041. Equipment, Assemblies and Components

None.

6042. Test and Production Equipment

None.

6043. Materials

1. Composite and composite modified double-base propellants.
2. Fuel substances as follows:
   a. Hydrazine with a concentration of more than 70 percent and its derivatives including monomethylhydrazine (MMH);
   b. Unsymetrical dimethylhydrazine (UDMH);
   c. Spherical aluminum powder with particles of uniform diameter of less than 200 x 10^{-6} m (200 µm) and an aluminum content of 97 percent by weight or more, if at least 10 percent of the total weight is made up of particles of less than 63 x 10^{-6} m (63 µm), according to ISO 2591:1988 or national equivalents such as JIS Z8820;
      Technical Note:
      A particle size of 63 µm (ISO R-565) corresponds to 250 mesh (Tyler) or 230 mesh (ASTM standard E-11).

   d. Zirconium, beryllium, magnesium and alloys of these in particle size less than 60 x 10^{-6} m (60 µm), whether spherical, atomised, spheroidal, flaked or ground, consisting of 97 percent by weight or more of any of the above mentioned metals;
      Technical Note:
      The natural content of hafnium in the zirconium (typically 2% to 7%) is counted with the zirconium.

   e. Boron and boron alloys in particle size less than 60 x 10^{-6} m (60 µm), whether spherical, atomised, spheroidal, flaked or ground with a purity of 85 percent by weight or more;
   f. High energy density materials such as boron slurry, having an energy density of 40 x 10^{6} J/kg or greater.
3. Oxidisers/Fuels as follows:
   a. Perchlorates, chlorates or chromates mixed with powdered metals or other high energy fuel components.
4. Oxidiser substances as follows:
   a. Liquid oxidiser substances as follows:
      1. Dinitrogen trioxide;
      2. Nitrogen dioxide/dinitrogen tetroxide;
      3. Dinitrogen pentoxide;
      4. Inhibited Red Fuming Nitric Acid (IRFNA);
      5. Compounds composed of fluorine and one or more of other halogens, oxygen or nitrogen;

6043.4. con't.

b. Solid oxidiser substances as follows:
   1. Ammonium perchlorate;
   2. Ammonium dinitramide (ADN);
   3. Nitro-amines (cyclotetramethylene - tetranitramine (HMX); cyclotrimethylene - trinitramine (RDX).

5. Polymeric substances, as follows:
   a. Carboxy - terminated polybutadiene (CTPB);
   b. Hydroxy - terminated polybutadiene (HTPB);
   c. Glycidyl azide polymer (GAP);
   d. Polybutadiene - Acrylic Acid (PBAA);
   e. Polybutadiene - Acrylic Acid- Acrylonitrile (PBAN).
6. Other propellant additives and agents as follows:
   a. Bonding agents as follows:
      1. tris (1-(2-methyl)aziridinyl) phosphine oxide (MAPO);
      2. trimesoyl-1 (2-ethyl) aziridine (HX-868, BITA);
      3. Tepanol (HX878), reaction product of tetraethlylene-pentamine, acrylonitrile and glycidol;
      4. Tepan (HX-879), reaction product of tetraethlylene-pentamine and acrylonitrile;
      5. 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);
   b. Curing agent and catalysts as follows:
      1. Triphenyl bismuth (TPB);
   c. Burning rate modifiers as follows:
      1. Catocene;
      2. N-butyl-ferrocene;
      3. Butacene;
      4. Other ferrocene derivatives;
      5. Carboranes, decarboranes, pentaboranes and derivatives thereof;
   d. Nitrate esters and nitrated plasticisers as follows:
      1. Triethylene glycol dinitrate (TEGDN);
      2. Trimethylolethane trinitrate (TMETN);
      3. 1,2,4-butanetriol trinitrate (BTTN);
      4. Diethylene glycol dinitrate (DEGDN);
   e. Stabilisers as follows:
      1. 2-Nitrodiphenylamine;
      2. N-methyl-p-nitroaniline.

6044. Software

None.

6045. Technology

1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of materials specified in 6043. (See also item 6055.)

Category 6050: Propellant Production

6051. Equipment, Assemblies and Components

None.

6052. Test and Production Equipment

1. "Production equipment", and specially designed components therefore, for the "production", handling or acceptance testing of liquid propellants or propellant constituents specified in 6040.
2. "Production equipment", other than that described in 6052.3., and specially designed components therefore, for the production, handling, mixing, curing, casting, pressing, machining, extruding or acceptance testing of solid propellants or propellant constituents specified in 6040.
3. Equipment as follows, and specially designed components therefore:
   a. Batch mixers with provision for mixing under vacuum in the range of zero to 13.326 kPa and with temperature control capability of the mixing chamber and having all of the following:
      1. a total volumetric capacity of 110 litres or more; **and**
      2. at least one mixing/kneading shaft mounted off centre;
   b. Continuous mixers with provision for mixing under vacuum in the range of zero to 13.326 kPa and with temperature control capability of the mixing chamber and having all of the following:
      1. two or more mixing/kneading shafts; **and**
      2. capability to open the mixing chamber;
   c. Fluid energy mills usable for grinding or milling substances specified in 6040.;
   d. Metal powder "production equipment" usable for the "production", in a controlled environment, of spherical or atomised materials specified in 6043.2.c., 6043.2.d., or 6043.2.e.

Note: 6052.3.d. includes

1. Plasma generators (high frequency arc-jet) usable for obtaining sputtered or spherical metallic powders with organization of the process in an argon-water environment;
2. Electroburst equipment usable for obtaining sputtered or spherical metallic powders with organization of the process in an argon-water environment;
3. Equipment usable for the "production" of spherical aluminum powders by powdering a melt in an inert medium (e.g., nitrogen).

Notes:

1. The only batch mixers, continuous mixers usable for solid propellants or propellants constituents specified in 6040., and fluid energy mills controlled in 6050., are those specified in 6052.3.
2. Forms of metal powder "production equipment" not specified in 6052.3.d. are to be evaluated in accordance with 6052.2.

6053. Materials

None.

6054. Software

1. "Software" specially designed or modified for the "use" of equipment specified in 6052. for the "production" and handling of materials specified in 6040.

6055. Technology

1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment specified in 6052.

Category 6060: Production of Structural Composites

6061. Equipment, Assemblies and Components

None.

6062. Test and Production Equipment

1. Equipment for the "production" of structural composites, fibres, prepregs or preforms, usable in the systems specified in 6011., as follows, and specially designed components, and accessories therefore:
   a. Filament winding machines of which the motions for positioning, wrapping and winding fibres can be co-ordinated and programmed in three or more axes, designed to fabricate composite structures or laminates from fibrous or filamentary materials, and co-ordinating and programming controls;
   b. Tape-laying machines of which the motions for positioning and laying tape and sheets can be co-ordinated 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;
   Note:
   6062.1.c. does not control textile machinery not modified for the end-uses stated.
   d. Equipment designed or modified for the production of fibrous or filamentary materials as follows:
      1. Equipment for converting polymeric fibres (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;
      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, including rollers, tension stretchers, coating equipment, cutting equipment and clicker dies.

Note:
Examples of components and accessories for the machines specified in 6062.1. are moulds, mandrels, dies, fixtures and tooling for the preform pressing, curing, casting, sintering or bonding of composite structures, laminates and manufactures thereof.

6063. Materials

None.

6064. Software

1. "Software" specially designed or modified for the "use" of equipment specified in 6062.

6065. Technology

1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 6062. or 6064.
2. "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 processed composites, usable for equipment or materials specified in 6080.

Category 6070: Pyrolytic Deposition and Densification

6071. Equipment, Assemblies and Components

None.

6072. Test and Production Equipment

1. Nozzles specially designed for the processes referred to in 6075.1.
2. 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.
3. Chemical vapour deposition furnaces designed or modified for the densification of carbon-carbon composites.
4. Equipment and process controls, other than those specified in 6072.2. or 6072.3., designed or modified for densification and pyrolysis of structural composite rocket nozzles and reentry vehicle nose tips.

6073. Materials

None.

6074. Software

1. "Software" specially designed or modified for the equipment specified in 6072.2., 6072.3. or 6072.4.

6075. Technology

1. "Technology" for producing pyrolytically derived materials formed on a mould, mandrel or other substrate from precursor gases which decompose in the 1300°C to 2900°C temperature range at pressures of 130 Pa (1 mm Hg) to 20 kPa (150 mm Hg) including "technology" for the composition of precursor gases, flow-rates, and process control schedules and parameters.
2. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 6072. or 6074.

Category 6080: Structural Material

6081. Equipment, Assemblies and Components

1. Composite structures, laminates, and manufactures thereof, specially designed for use in the systems specified in 6011. and the subsystems specified in 6021.
2. Resaturated pyrolised (i.e., carbon-carbon) components having all of the following:
   a. designed for rocket systems; **and**
   b. usable in the systems specified in 6011.

6082. Test and Production Equipment

None.

6083. Materials

1. Resin impregnated fibre prepregs and metal coated fibre preforms, for the goods specified in 6081.1., made either with organic matrix or metal matrix utilizing fibrous or filamentary reinforcements having a specific tensile strength greater than 7.62×10^4 m and a specific modulus greater than 3.18×10^6 m.
   Note:
   The only resin impregnated fibre prepregs specified in 6083.1. are those using resins with a glass transition temperature (Tg), after cure, exceeding 145oC as determined by ASTM D4065 or national equivalents.

2. Resaturated pyrolised (i.e., carbon-carbon) materials having all of the following:
   a. designed for rocket systems; **and**
   b. usable in the systems specified in 6011.
3. Fine grain recrystallised bulk graphites (with a bulk density of at least 1.72 g/cm^3 measured at 15°C) and having a particle size of 100×10^{-6} m (100 µm) or less, usable for rocket nozzles and re-entry vehicle nose tips as follows:
   a. cylinders having a diameter of 120 mm or greater and a length of 50 mm or greater,
   b. tubes having an inner diameter of 65 mm or greater and a wall thickness of 25 mm or greater and a length of 50 mm or greater,
   c. blocks having a size of 120 mm x 120 mm x 50 mm or greater.
4. Pyrolytic or fibrous reinforced graphites usable for rocket nozzles and re-entry vehicle nose tips usable in systems specified in 6011.
5. Ceramic composite materials (dielectric constant less than 6 at frequencies from 100 Hz to 10 GHz) for use in missile radomes usable in systems specified in 6011.
6. Bulk machinable silicon-carbide reinforced unfired ceramic usable for nose tips usable in systems specified in 6011.
7. Tungsten, molybdenum, and alloys of these metals in the form of uniform spherical or atomised particles of 500×10^{-6} m (500 µm) diameter or less with a purity of 97% or higher for fabrication of rocket motor components, i.e., heat shields, nozzle substrates, nozzle throats, and thrust vector control surfaces, usable in systems specified in 6011.
8. Maraging steels having an Ultimate Tensile Strength of 1.5×10^9 Pa or greater, measured at 20°C, in the form of sheet, plate or tubing with a wall or plate thickness equal to or less than 5.0 mm usable in systems specified in 6011.

   Technical Note:
   Maraging steels are generally characterised by high nickel, very low carbon content and use substitutional elements or precipitates to produce age-hardening.

9. Titanium-stabilised duplex stainless steel (Ti-DSS) usable in the systems specified in 6011. and having:
   a. All of the following characteristics:
      1. containing 17.0 - 23.0 weight percent chromium and 4.5 - 7.0 weight percent nickel,
      2. having a titanium content of greater than 0.10 weight percent; **and**
      3. a ferritic-austenitic microstructure (also referred to as a two-phase microstructure) of which at least 10 percent is austenite by volume (according to ASTM E-1181-87 or national equivalents), **and**
   b. Having any of the following forms:
      1. ingots or bars having a size of 100 mm or more in each dimension,
      2. sheets having a width of 600 mm or more and a thickness of 3 mm or less, **or**
      3. tubes having an outer diameter of 600 mm or more and a wall thickness of 3 mm or less.

6084. Software

None.

6085. Technology

1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or materials specified in 6081. or 6083.

Category 6090: Instrumentation, Navigation and Direction Finding

6091. Equipment, Assemblies and Components

1. Integrated flight instrument systems which include gyrostabilisers or automatic pilots, designed or modified for use in the systems specified in 6011., and specially designed components therefore.
2. Gyro-astro compasses and other devices which derive position or orientation by means of automatically tracking celestial bodies or satellites, and specially designed components therefore.
3. Accelerometers with a threshold of 0.05 g or less, or a linearity error within 0.25% of full scale output, or both, which are designed for use in inertial navigation systems or in guidance systems of all types, and specially designed components therefore.
   Note:
   Accelerometers which are specially designed and developed as MWD (Measurement While Drilling) sensors for use in downhole well service operations are not controlled in 6091.3.

4. All types of gyros usable in the systems specified in 6011., with a rated 'drift rate' 'stability' of less than 0.5 degrees (1 sigma or rms) per hour in a 1 g environment and specially designed components therefore.

6091.4. con't.

Technical Notes:

1. *'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.*
2. *'Stability' is defined as the 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.*

5. Continuous output accelerometers or gyros of any type, specified to function at acceleration levels greater than 100 g, and specially designed components therefore.
6. Inertial or other equipment using accelerometers specified in 6091.3. or 6091.5. or gyros specified in 6091.4. or 6091.5., and systems incorporating such equipment, and specially designed components therefore.

6092. Test and Production Equipment

1. "Production equipment", and other test, calibration and alignment equipment, other than that described in 6092.2., designed or modified to be used with equipment specified in 6091.

Note:

Equipment specified in 6092.1. includes the following:

1. *For laser gyro equipment, the following equipment used to characterise 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) Tester;*
   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.*

2. Equipment as follows:
   a. Balancing machines having all the following characteristics:
      1. not capable of balancing rotors/assemblies having a mass greater than 3 kg;
      2. capable of balancing rotors/assemblies at speeds greater than 12,500 rpm;
      3. capable of correcting unbalance in two planes or more; **and**
      4. capable of balancing to a residual specific unbalance of 0.2g mm per kg of rotor mass;
   b. Indicator heads (sometimes known as balancing instrumentation) designed or modified for use with machines specified in 6092.2.a.;
   c. Motion simulators/rate tables (equipment capable of simulating motion) having all of the following characteristics:
      1. two axes or more;
      2. slip rings capable of transmitting electrical power and/or signal information; **and**
      3. having any of the following characteristics:
         a. for any single axis having all of the following:
            1. capable of rates of 400 degrees/s or more, or 30 degrees/s or less; **and**
            2. a rate resolution equal to or less than 6 degrees/s and an accuracy equal to or less than 0.6 degrees/s;
         b. having a worst-case rate stability equal to or better (less) than plus or minus 0.05% averaged over 10 degrees or more; **or**
         c. a positioning accuracy equal to or better than 5 Arc second;
   d. Positioning tables (equipment capable of precise rotary positioning in any axes) having the following characteristics:
      1. two axes or more; **and**
      2. a positioning accuracy equal to or better than 5 Arc second;
   e. Centrifuges capable of imparting accelerations above 100 g and having slip rings capable of transmitting electrical power and signal information.

Notes:

1. *The only balancing machines, indicator heads, motion simulators, rate tables, positioning tables and centrifuges specified in Category 6090 are those specified in 6092.2.*
2. *6092.2.a. does not control balancing machines designed or modified for dental or other medical equipment.*
3. *6092.2.c. and 6092.2.d. do not control rotary tables designed or modified for machine tools or for medical equipment.*
4. *Rate tables not controlled by 6092.2.c. and providing the characteristics of a positioning table are to be evaluated according to 6092.2.d.*
5. *Equipment that has the characteristics specified in 6092.2.d. which also meets the characteristics of 6092.2.c. will be treated as equipment specified in 6092.2.c.*

6093. Materials

None.

6094. Software

1. "Software" specially designed or modified for the "use" of equipment specified in 6091. or 6092.
2. Integration "software" for the equipment specified in 6091.1.
3. Integration "software" specially designed for the equipment specified in 6091.6.

6095. Technology

1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 6091., 6092. or 6094.

Note:

Equipment or "software" specified in 6091. or 6094. may be exported as part of a manned aircraft, satellite, land vehicle or marine vessel or in quantities appropriate for replacement parts for such applications.

Category 6100: Flight Control

6101. Equipment, Assemblies and Components

1. Hydraulic, mechanical, electro-optical, or electromechanical flight control systems (including fly-by-wire systems) designed or modified for the systems specified in 6011.
2. Attitude control equipment designed or modified for the systems specified in 6011.

6101. con't.

Note:

Systems or equipment specified in 6101. may be exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.

6102. Test and Production Equipment

1. Test, calibration, and alignment equipment specially designed for equipment specified in 6101.

6103. Materials

None.

6104. Software

1. "Software" specially designed or modified for the "use" of equipment specified in 6101. or 6102.

   Note:

   Governments may permit the export of "software" specified in 6104.1. as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.

6105. Technology

1. Design "Technology" for integration of air vehicle fuselage, propulsion system and lifting control surfaces, designed or modified for the systems specified in 6011., to optimise aerodynamic performance throughout the flight regime of an unmanned air vehicle.
2. Design "Technology" for integration of the flight control, guidance, and propulsion data into a flight management system, designed or modified for the systems specified in 6011., for optimisation of rocket system trajectory.
3. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 6101., 6102. or 6104.

Category 6110: Avionics

6111. Equipment, Assemblies and Components

1. Radar and laser radar systems, including altimeters, designed or modified for use in the systems specified in 6011.

   Technical Note:

   Laser radar systems embody specialised transmission, scanning, receiving and signal processing techniques for utilisation of lasers for echo ranging, direction finding and discrimination of targets by location, radial speed and body reflection characteristics.

2. Passive sensors for determining bearings to specific electromagnetic sources (direction finding equipment) or terrain characteristics, designed or modified for use in the systems specified in 6011.
3. Global Positioning System (GPS) or similar satellite receivers, designed or modified for use in the systems specified in 6011., having any of the following characteristics:
   a. Capable of providing navigation information under the following operational conditions:
      1. At speeds in excess of 515 m/s (1,000 nautical miles/hour); **and**
      2. At altitudes in excess of 18 km (60,000 feet); **or**
   b. Designed or modified for use with unmanned air vehicles specified in 6011.2.
4. Electronic assemblies and components, designed or modified for use in the systems specified in 6011. and specially designed for military use and operation at temperatures in excess of 125°C.

Notes:

1. *Equipment specified in 6111. includes the following:*
   a. Terrain contour mapping equipment;
   b. Scene mapping and correlation (both digital and analogue) equipment;
   c. Doppler navigation radar equipment;
   d. Passive interferometer equipment;
   e. Imaging sensor equipment (both active and passive).
2. *Equipment specified in 6111. may be exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.*

6112. Test and Production Equipment

None.

6113. Materials

None.

6114. Software

1. "Software" specially designed or modified for the "use" of equipment specified in 6111.1., 6111.2. or 6111.4.
2. "Software" specially designed for the "use" of equipment specified in 6111.3.

6115. Technology

1. Design "Technology" for protection of avionics and electrical subsystems against electromagnetic pulse (EMP) and electromagnetic interference (EMI) hazards from external sources, as follows:
   a. Design "technology" for shielding systems;
   b. Design "technology" for the configuration of hardened electrical circuits and subsystems;
   c. Design "technology" for determination of hardening criteria for the above.
2. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 6111. or 6114.

Category 6120: Launch Support

6121. Equipment, Assemblies and Components

1. Apparatus and devices, designed or modified for the handling, control, activation and launching of the systems specified in 6011.
2. Vehicles designed or modified for the transport, handling, control, activation and launching of the systems specified in 6011.

6121. con't.

3. Gravity meters (gravimeters), gravity gradiometers, and specially designed components therefore, designed or modified for airborne or marine use, and having a static or operational accuracy of 7×10^{-6} m/s^2 (0.7 milligal) or better, with a time to steady-state registration of two minutes or less, usable for systems specified in 6011.
4. Telemetry and telecontrol equipment having all of the following:
   a. usable for unmanned air vehicles or rocket systems; **and**
   b. usable for systems specified in 6011.
5. Precision tracking systems, usable for systems specified in 6011., as follows:
   a. 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 inflight position and velocity;
   b. Range instrumentation radars including associated optical/infrared trackers with all of the following capabilities:
      1. angular resolution better than 3 mrad (0.5 mils);
      2 range of 30 km or greater with a range resolution better than 10 m RMS; **and**
      3. velocity resolution better than 3 m/s.

6122. Test and Production Equipment

None.

6123. Materials

None.

6124. Software

1. "Software" specially designed or modified for the "use" of equipment specified in 6121.1.
2. "Software" which processes post-flight, recorded data, enabling determination of vehicle position throughout its flight path, specially designed or modified for systems specified in 6011.
3. "Software" specially designed or modified for the "use" of equipment specified in 6121.4. or 6121.5., usable for systems specified in 6011.

6125. Technology

1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 6121. or 6124.

Category 6130: Computers

6131. Equipment, Assemblies and Components

1. Analogue computers, digital computers or digital differential analyzers, designed or modified for use in the systems specified in 6011., having any of the following characteristics:
   a. Rated for continuous operation at temperatures from below -45°C to above +55°C; **or**
   b. Designed as ruggedised or "radiation hardened".

6132. Test and Production Equipment

None.

6133. Materials

None.

6134. Software

None.

6135. Technology

1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment specified in 6131.

Note:
Item 6130. equipment may be exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.

Category 6140: Analogue to Digital Converters

6141. Equipment, Assemblies and Components

1. Analogue-to-digital converters, usable in the systems specified in 6011., having any of the following characteristics:
   a. Designed to meet military specifications for ruggedised equipment; or
   b. Designed or modified for military use and being one of the following types:
      1. Analogue-to-digital converter "microcircuits", which are "radiation-hardened" or have all of the following characteristics:
         a. Having a quantisation corresponding to 8 bits or more when coded in the binary system;
         b. Rated for operation in the temperature range from below -54°C to above +125°C ; **and**
   c. Hermetically sealed; OR
2. Electrical input type analogue-to-digital converter printed circuit boards or modules, having all of the following characteristics:
   a. Having a quantisation corresponding to 8 bits or more when coded in the binary system;
   b. Rated for operation in the temperature range from below -45°C to above +55°C; and
   c. Incorporating "microcircuits" specified in 6141.1.b.1.

6142. Test and Production Equipment

None.

6143. Materials

None.

6144. Software

None.

6145. Technology

1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment specified in 6141.

Category 6150: Test Facilities and Equipment

6151. Equipment, Assemblies and Components

None.

6152. Test and Production Equipment

1. Vibration test equipment, usable for the systems specified in 6011. or the subsystems specified in 6021., and components therefore, as follows:
   a. 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 to 2 kHz and imparting forces of 50 kN (11,250 lbs), measured bare table, or greater;
   b. 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 specified in 6152.1.a;
   c. Vibration thrusters (shaker units), with or without associated amplifiers, capable of imparting a force of 50 kN (11,250 lbs), measured bare table, or greater, and usable in vibration test systems specified in 6152.1.a;
   d. 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 50 kN, measured bare table, or greater, and usable in vibration test systems specified in 6152.1.a.

   Technical Note:
   Vibration test systems incorporating a digital controller are those systems, the functions of which are, partly or entirely, automatically controlled by stored and digitally coded electrical signals.

2. Wind-tunnels for speeds of Mach 0.9 or more, usable for the systems specified in 6011. or the subsystems specified in 6021.
3. Test benches/stands, usable for the systems specified in 6011. or the subsystems specified in 6021., which have the capacity to handle solid or liquid propellant rockets, motors or engines of more than 90 kN (20,000 lbs) of thrust, or which are capable of simultaneously measuring the three axial thrust components.
4. Environmental chambers and anechoic chambers, as follows, usable for the systems specified in 6011. or the subsystems specified in 6021.:
   a. Environmental chambers capable of simulating all of the following flight conditions:
      1. Vibration environments of 10 g RMS or greater between 20 Hz and 2 kHz imparting forces of 5 kN or greater; **and**
      2. any of the following:
         a. Altitude of 15,000 m or greater; **or**
         b. Temperature range of at least -50°C to 125° C;
   b. Anechoic chambers capable of simulating all of the following flight conditions:
      1. Acoustic environments at an overall sound pressure level of 140 dB or greater (referenced to 2 x 10^{-5} N/m^2) or with a rated power output of 4 kW or greater; **and**
      2. any of the following:
         a. Altitude of 15,000 m or greater; **or**
         b. Temperature range of at least -50°C to 125°C.
5. Accelerators capable of delivering electromagnetic radiation produced by bremsstrahlung from accelerated electrons of 2 MeV or greater, and equipment containing those accelerators, usable for the systems specified in 6011. or the subsystems specified in 6021.

   Note:
   6152.5. does not control equipment specially designed for medical purposes.

6153. Materials

None.

6154. Software

1. "Software" specially designed or modified for the "use" of equipment specified in 6152. usable for testing systems specified in 6011. or subsystems specified in 6021.

6155. Technology

1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 6152. or 6154.

Category 6160: Modeling-Simulation and Design Integration

6161. Equipment, Assemblies and Components

1. Specially designed hybrid (combined analogue/digital) computers for modeling, simulation or design integration of systems specified in 6011. or the subsystems specified in 6021.

   Note:
   This control only applies when the equipment is supplied with "software" specified in 6164.1.

6162. Test and Production Equipment

None.

6163. Materials

None.

6164. Software

1. "Software" specially designed for modeling, simulation, or design integration of the systems specified in 6011. or the subsystems specified in 6021.
   Technical Note:
   The modeling includes in particular the aerodynamic and thermodynamic analysis of the systems.

6165. Technology

1."Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 6161. or 6164.

Category 6170: Stealth

6171. Equipment, Assemblies and Components

1. Devices for reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures (i.e., stealth technology), for applications usable for the systems specified in 6011. or the subsystems specified in 6021.

6172. Test and Production Equipment

1. Systems, specially designed for radar cross section measurement, usable for the systems specified in 6011. or the subsystems specified in 6021.

6173. Materials

1. Materials for reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures (i.e. stealth technology), for applications usable for the systems specified in 6011. or the subsystems specified in 6021.
   Note
   6173.1. includes structural materials and coatings (including paints), specially designed for reduced or tailored reflectivity or emissivity in the microwave, infrared or ultraviolet spectra.
   Note 2:
   6173.1. does not control coatings (including paints) when specially used for thermal control of satellites.

6174. Software

1. "Software" specially designed for reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures (i.e. stealth technology), for applications usable for the systems specified in 6011. or the subsystems specified in 6021.
   Note:
   6174.1. includes "software" specially designed for analysis of signature reduction.

6175. Technology

1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment, materials or "software" specified in 6171., 6172., 6173. or 6174.
   Note:
   6175.1. includes databases specially designed for analysis of signature reduction.

Category 6180: Nuclear Effects Protection

6181. Equipment, Assemblies and Components

1. "Radiation Hardened" "microcircuits" usable 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 specified in 6011).
2. ´Detectors´ specially designed or modified to protect 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 specified in 6011).
   Technical Note:
   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. This includes devices that sense by one time operation or failure.

3. Radomes designed to withstand a combined thermal shock greater than 4.184 x 106 $^{J/m2}$ accompanied by a peak over pressure of greater than 50 kPa, usable 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 specified in 6011).

6182. Test and Production Equipment

None.

6183. Materials

None.

6184. Software

None

6185. Technology

1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment specified in 6181.

Category 6190: Other Complete Delivery Systems

6191. Equipment, Assemblies and Components

1. Complete rocket systems (including ballistic missile systems, space launch vehicles, and sounding rockets), not specified in 6011.1., capable of a maximum range equal to or greater than 300 km.
2. Complete unmanned air vehicle systems (including cruise missile systems, target drones and reconnaissance drones), not specified in 6011.2., capable of a maximum range equal to or greater than 300 km.
   (All destinations)

6192. Test and Production Equipment

None.

6193. Materials

None.

6194. Software

1. "Software" which coordinates the function of more than one subsystem, specially designed or modified for "use" in the systems specified in 6191.

6195. Technology

1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment specified in 6191.

Category 6200: Other Complete Subsystems

6201. Equipment, Assemblies and Components

1. Complete subsystems as follows:
   a. Individual rocket stages, not specified in 6021.1., usable in systems specified in 6191.
   b. Solid propellant rocket motors or liquid propellant rocket engines, not specified in 6021.1., usable in systems specified in 6191., having a total impulse capacity of 8.41 x 10^5 N s (1.91 x 10^5 lb s) or greater, but less than 1.1 x 10^6 N s (2.5 x 10^5 lb s).

6202. Test and Production Equipment

1. "Production facilities" specially designed for the subsystems specified in 6201.
2. "Production equipment" specially designed for the sub-systems specified in 6201.

6203. Materials

None.

6204. Software

1. "Software" specially designed or modified for the systems specified in 6202.1.
2. "Software", not specified in 6024.2., specially designed or modified for the "use" of rocket motors or engines specified in 6201.1.b.

6205. Technology

1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 6201., 6202. or 6204.

Group 6 - Definitions

For the purpose of this Annex, the following definitions apply:

"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"
Is related to all phases prior to "production" such as: 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.

"In the public domain"
This means "software" or "technology" which has been made available without restrictions upon its further dissemination.
N.B.:
Copyright restrictions do not remove "software" or "technology" 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.

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

"Production"
Means all production phases such as: production engineering, manufacture, integration, assembly (mounting), inspection, testing, quality assurance.

"Production equipment"
Means tooling, templates, jigs, mandrels, moulds, dies, fixtures, alignment mechanisms, test equipment, other machinery and components therefore, limited to those specially designed or modified for "development" or for one or more phases of "production".

"Production facilities"
Means equipment and specially designed "software" therefore integrated into installations for "development" or for one or more phases of "production".

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

"Radiation Hardened"
Means that the component or equipment is designed or rated to withstand radiation levels which meet or exceed a total irradiation dose of 5 x 105 rads (Si).

"Software"
A collection of one or more "programmes", or "micro-programmes", fixed in any tangible medium of expression.

"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, engineering designs and specifications, manuals and instructions written or recorded on other media or devices such as: disk, tape, read-only memories.

"Technology"

Means specific information which is required for the "development", "production" or "use" of a product. The information may take the form of "technical data" or "technical assistance".

"Use"

Means:

Operation, installation (including on-site installation), maintenance, repair, overhaul, refurbishing.

Group 6 - Terminology

N.B.:

Where the following terms appear in the text, they are to be understood according to the explanations below:

"Designed or Modified"

describes Equipment, parts or components 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.

"Specially Designed"

describes 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.

Statement of Understanding

Members agree that, in those cases where the term "national equivalents" are specifically allowed as alternatives to specified International Standards, the technical methods and parameters embodied in the national equivalent would ensure that the requirements of the standard set by the specified International Standards are met.

Group 7 – Chemical and Biological Weapons Non-Proliferation List

Notes:

1. *Terms in "double quotation marks" are defined terms. Refer to"Group 7 - Definitions".*
2. *In items 7003. and 7004. the numbers in brackets following the chemical name in each item 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.*
3. *Mixtures containing any quantity of CWC Schedule 1A and 1B chemicals/precursors (Items 7003.1. and 7003.2.) are also controlled.*
4. *Mixtures containing any quantity of chemicals/precursors listed in the CWC Schedules 2A, 2B, 3A and 3B (items 7003.3. through 7003.6.) and Australia Group (item 7004.) are controlled unless the listed chemical is merely an impurity that was not intentionally added or is a normal ingredient in consumer goods packaged for retail sale for personal use.*
5. *I tems 7001. and 7003. are based on the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction. (known as the Chemical Weapons Convention or CWC.) The other items in the Group are based on the Australia Group (AG).*

Category 7000: Chemical Weapons

7001. Equipment, Assemblies and Components

1. CWC Chemical Weapon Production Equipment.
   a. Specialised equipment, as follows:
      1. The main production train, including any reactor or equipment for product synthesis, separation or purification, any equipment used directly for heat transfer in the final technological stage, such as in reactors or in product separation, as well as any other equipment which has been in contact with any chemical in items 7003.1. and 7003.2. or would be in contact with such chemical if the facility were operated;
      2. Any chemical weapons filling machines;
      3. Any other equipment specially designed, built or installed for the operation of the facility as a chemicals weapons production facility, as distinct from a facility constructed according to prevailing commercial standards for facilities not producing any chemical not specified in items 7003.1. and 7003.2., or corrosive chemicals, such as; special equipment for waste control, waste treatment, air filtering, or solvent recovery; special containment enclosures and safety shields; non-standard laboratory equipment used to analyze toxic chemicals for chemical weapons purposes; custom-designed process control panels; or dedicated spares for specialised equipment.
   b. Standard Equipment
      1. Production equipment which is generally used in the chemical industry and is not included in the types of specialised equipment noted in Item 7001.1.a.
      2. Other equipment commonly used in the chemical industry, such as; fire-fighting equipment; security/safety surveillance equipment; medical facilities, laboratory facilities, or communications equipment.
2. CWC Chemical Weapons Facilities.
   'Chemicals Weapons Facility' in the context of this item means an industrial site containing production units and auxiliary units, such as those listed below, which are under one operational control:
   a. Production unit;
   b. Administration, record keeping, and stores sections;
   c. Utility, repair and maintenance shops;
   d. Central, local control, and research laboratories;
   e. First aid and medical centre;
   f. Effluent, waste handling /treatment plant.

7002. AG 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^3 (100 l) and less than 20 m^3 (20,000 l);
   b. Agitators for use in reaction vessels or reactors; and impellers, blades or shafts for such agitators listed in Item 7002.1.a;
   c. Storage Tanks, Containers or Receivers, with a total internal (geometric) volume greater than 0.1 m^3 (100 l);
   d. Heat exchangers or Condensers with a heat transfer surface area of greater than 0.15 m^2, and less than 20 m^2; and tubes, plates, coils, or blocks (cores) designed for such heat exchangers or condensers.
   e. Distillation or Absorption Columns of internal diameter greater than 0.1 m; and liquid distributors, vapour distributors or liquid distributors designed for such distillation or absorption columns.
   f. Multiple-seal valves incorporating a leak detection port, bellows-seal valves, non-return (check) valves or diaphragm valves; and casings (valve bodies) or preformed casing liners designed for such valves.
   g. Multi-walled Piping incorporating a leak detection port;
   h. Multi-seal, canned drive, magnetic drive, bellows or diaphragm pumps, with manufacturer's specified maximum flow-rate greater than 0.6 m^3/h, or vacuum pumps with the manufacturer's specified maximum flowrate greater than 5 m^3/h (under standard temperature (0°C) and pressure (101.30 kPa) conditions); and casings (pump bodies), preformed casing liners, impellers, rotors, or jet pump nozzles designed for such pumps.

Technical Note:

Items listed in 7002.1.a. through h. are 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 enameled coating);*
5. *Graphite or carbon graphite(applies only to heat exchangers, condensers, distillation and absorption columns, multi-walled piping and pumps);*
6. *Tantalum or tantalum alloys;*

7002.h.notes con't.

7. *Titanium or titanium alloys;*
8. *Zirconium or zirconium alloys;*
9. *Ceramics (applies only to pumps)*
10. *Ferrosilicon (applies only to pumps).*
11. *Silicon carbide (applies only to heat exchanges and condensers); or*
12. *Titanium carbide (applies only to heat exchanges and condensers*

2. Remotely operated filling equipment in which all surfaces that come into contact with the chemical(s) being processed are made of the following materials:
   a. Nickel or alloys with more than 40% nickel by weight; or
   b. Alloys with more than 25% nickel and 20% chromium by weight

   Technical Note:
   1. *Items are considered to be included only if all surfaces that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:*
      a. *Nickel or alloys with more than 40% nickel by weight; or*
      b. *Alloys with more than 25% nickel and 20% chromium by weight.*
   2. *Carbon graphite is a composition consisting of amorphous carbon and graphite, in which the graphite content is 8% or more by weight.*
3. Incinerators designed to destroy CW agents, 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 7002.3.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, or AG-controlled precursors at concentrations of less than 0.3 mg/m^3; **or**
   b. Designed for the detection of cholinesterase-inhibiting activity.

Note:
Governments may permit the shipment of equipment (identified in Item 7002.) 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 7004.

*(Item 7002. applies to all destinations **except** Argentina, Australia, Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Republic of Korea, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Slovak Republic, Spain, Sweden, Switzerland, United Kingdom and United States.)*

7003. CWC Materials

1. CWC Schedule 1 A Toxic Chemicals:

a. O-Alkyl (equal to or less than C10, including cycloalkyl) alkyl (Methyl, Ethyl, n-Propyl or Isopropyl) - phosphonofluoridate;
   e.g. **Sarin** (GB):O-Isopropyl methylphosphono-fluoridate, (CAS 107-44-8);
   Soman (GD):O-Pinacolyl methyl-phosphono-fluoridate, (CAS 96-64-0);

b. **O-Alkyl** (equal to or less than C_{10}, including cycloalkyl) N,N-dialkyl (Methyl, Ethyl, n-Propyl or Isopropyl) phosphoramidocyanidates, e.g., Tabun: O-Ethyl N,N-dimethylphosphoramidocyanidate, (CAS 77-81-6);

c. **O-Alkyl** (H or equal to or less than C_{10}, including cycloalkyl) S-2-dialkyl (Methyl, Ethyl, n-Propyl or Isopropyl)-aminoethyl alkyl (Methyl, Ethyl, n-Propyl or Isopropyl) phosphonothiolates and corresponding alkylated or protonated salts, e.g., VX: O-Ethyl S-2-diiso-propylaminoethyl methylphosphonothiolate, (CAS 50782-69-9);

d. **Sulphur mustards**:
   2-Chloroethylchloromethylsulphide, (CAS 2625-76-5);
   Mustard gas: Bis(2-chloroethyl) sulphide, (CAS 505-60-2);
   Bis(2-chloroethylthio) methane, (CAS 63869-13-6);
   Sesquimustard: 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, (CAS 142868-93-7);
   1,5-Bis(2-chloroethylthio) -n-pentane, (CAS 142868-94-8);
   Bis (2-chloroethylthiomethyl) ether; (CAS 63918-90-1);
   O-Mustard: Bis (2-chloroethylthioethyl) ether, (CAS 63918-89-8);

e. **Lewisites**:
   Lewisite 1: 2-chlorovinyldichloroarsine, (CAS 541-25-3);
   Lewisite 2: Bis (2-chlorovinyl) chloroarsine, (CAS 40334-69-8);
   Lewisite 3: Tris (2-chlorovinyl) arsine, (CAS 40334-70-1);

f. **Nitrogen mustards**:
   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. **Saxitoxin**, (CAS 35523-89-8);

h. **Ricin**, (CAS 9009-86-3).

2. CWC Schedule 1 B Precursors

a. Alkyl(Me, Et, n-Pr or i-Pr)phosphonyldifluorides
   e.g., DF: Methylphosphonyldifluoride, (CAS 676-99-3);

b. O-Alkyl (H equal to or less than C_{10}, including cycloalkyl) O-2-dialkyl (Me, Et, n-Pr or i-Pr)-aminoethyl alkyl (Me, Et, n-Pr or i-Pr) phosphonites and corresponding alkylated or protonated salts; e.g., QL: O-Ethyl O-2-diisopropylamino ethyl methyl-phosphonite, (CAS 57856-11-8);

c. Chlorosarin: O-Isopropyl methylphosphonochloridate, (CAS 1445-76-7);

d. Chlorosoman: O-Pinacolyl methylphosphonochloridate, (CAS 7040-57-5).

3. CWC Schedule 2 A Toxic Chemicals:

a. Amiton: O,O-Diethyl S-[2-(diethylamino)ethyl] phosphorothiolate, (CAS 78-53-5) and corresponding alkylated or protonated salts;

b. PFIB: 1,1,3,3,3-Pentafluoro-2-(trifluoromethyl)-1-propene, (CAS 382-21-8);

c. BZ: 3-Quinuclidinyl benzilate, (CAS 6581-06-2).

4. CWC Schedule 2 B Precursors:

a. Chemicals, except for those listed in Item 7003.1., or 7003.2. containing a phosphorus atom to which is bonded one methyl, ethyl or propyl (normal or iso) group but not further carbon atoms, such as:
   1. Dimethyl methylphosphonate, (CAS 756-79-6);
   2. Methyl phosphonyl dichloride, (CAS 676-97-1);

   Note:
   This Item does not control Fonofos: 0-Ethyl S-phenyl ethylphosphonothionate, (CAS 944-22-9).

7003. con't.

b. N,N-Dialkyl (Me, Et, n-Pr or i-Pr) phosphoramidic dihalides;
c. Dialkyl (Me, Et, n-Pr or i-Pr) N,N-Dialkyl (Me, Et, n-Pr or i-Pr)-phosphoramidates;
d. Arsenic trichloride, (CAS 7784-34-1);
e. 2,2-diphenyl-2-hydroxyacetic acid, (CAS 76-93-7);
f. Quinuclidin-3-ol, (CAS 1619-34-7);
g. N,N-Dialkyl (Me, Et, n-Pr or i-Pr) aminoethyl-2-chlorides and corresponding protonated salts;
h. N,N-Dialkyl (Me, Et, n-Pr or i-Pr) aminoethane-2-ols and corresponding protonated salts;

Note:
This Item does not control:
a. N,N-Dimethylaminoethanol, (CAS 108-01-0) and corresponding protonated salts.
b. N,N-Diethylaminoethanol, (CAS 100-37-8);

i. N,N-Dialkyl (Me, Et, n-Pr or i-Pr)aminoethane-2-thiols and corresponding protonated salts;
j. Thiodiglycol: Bis(2-hydroxyethyl)sulfide, (CAS 111-48-8);
k. Pinacolyl alcohol: 3,3-Dimethylbutan-2-ol, (CAS 464-07-3).

5. CWC Schedule 3 A Toxic Chemicals:

a. Phosgene: Carbonyl dichloride, (CAS 75-44-5);
b. Cyanogen chloride, (CAS 506-77-4);
c. Hydrogen cyanide, (CAS 74-90-8);
d. Chloropicrin: Trichloronitromethane, (CAS 76-06-2).

6. CWC Schedule 3 B Precursors:

a. Phosphorus oxychloride, (CAS 10025-87-3);
b. Phosphorus trichloride, (CAS 7719-12-2);
c. Phosphorus pentachloride, (CAS 10026-13-8);
d. Trimethyl phosphite, (CAS 121-45-9);
e. Triethyl phosphite, (CAS 122-52-1);
f. Dimethyl phosphite, (CAS 868-85-9);
g. Diethyl phosphite, (CAS 762-04-9);
h. Sulphur monochloride, (CAS 10025-67-9);
i. Sulphur dichloride, (CAS 10545-99-0);
j. Thionyl chloride, (CAS 7719-09-7);
k. Ethyl diethanolamine, (CAS 139-87-7);
l. Methyldiethanolamine, (CAS 105-59-9);
m. Triethanolamine, (CAS 102-71-6).

7004. AG Materials.

1. Chemical Weapons Precursor Chemicals, as follows:
   a. 3-hydroxy-1-methylpiperidine, (CAS 3554-74-3);
   b. Potassium fluoride, (CAS 7789-23-3);
   c. 2-chloroethanol, (CAS 107-07-3);
   d. Dimethylamine, (CAS 124-40-3);
   e. Dimethylamine hydrochloride, (CAS 506-59-2);
   f. Hydrogen fluoride, (CAS 7664-39-3);
   g. Methyl benzilate, (CAS 76-89-1);
   h. 3-quinuclidone, (CAS 3731-38-2);
   i. Pinacolone, (CAS 75-97-8);
   j. Potassium cyanide, (CAS 151-50-8);
   k. Potassium bifluoride, (CAS 7789-29-9);
   l. Ammonium bifluoride, (CAS 1341-49-7);
   m. Sodium bifluoride, (CAS 1333-83-1);
   n. Sodium fluoride, (CAS 7681-49-4);
   o. Sodium cyanide, (CAS 143-33-9);
   p. Phosphorous pentasulphide, (CAS 1314-80-3);
   q. Di-isopropylamine, (CAS 108-18-9);
   r. Diethylaminoethanol, (CAS 100-37-8);
   s. Sodium sulphide, (CAS 1313-82-2);
   t. Triethanolamine hydrochloride, (CAS 637-39-8).

(All destinations other than the United States)

Note:
Chemical compounds created with any chemical listed in item 7004. are not covered in item 7004. unless that compound itself is listed in item 7004.

Governments may permit the shipment of diagnostic, analytical and food testing kits containing small quantities of materials in Item 7004.

Note:
The term 'testing kit' means prepackaged materials of defined compositon containing small quantities of chemicals in Item 7004 which are specifically developed, packaged and marketed for diagnostic, analytical or public health purposes.

7005. Software.

None.

7006. Technology.

1. The transfer of "technology", including licences, directly associated with CW agents, AG-controlled precursors and AG-controlled dual-use equipment in items 7001. to 7004., is controlled.
2. 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 authorised.
3. Controls do not apply to information "in the public domain" or to "basic scientific research".

Category 7010: Biological Weapons

7011. Equipment, Assemblies and Components

None.

7012. 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 a capacity equal to or greater than 100 litres;
   Technical Note:
   For the purposes of Item 7012.2., sub-groups of fermenters include bioreactors, chemostats and continuous-flow systems.

3. Centrifugal separators capable of the continuous separation of pathogenic microorganisms, without the propagation of aerosols, and having all 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**

7012.3. con't.

d. capable of in-situ steam sterilisation in a closed state;

Technical Note:

For the purposes of Item 7012.3., centrifugal separators include decanters.

4. Cross (tangential) flow filtration equipment capable of continuous separation of pathogenic microorganisms, viruses, toxins and cell cultures without the propagation of aerosols, and having all the following characteristics:
   a. equal to or greater than 5 square metres;
   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;
   b. Class III biological safety cabinets or isolators with similar performance standards. (e.g. flexible isolators, dry boxes, anaerobic chambers, glove boxes, or laminar flow hoods)
7. Aerosol inhalation chambers designed for aerosol challenge testing with pathogenic microorganisms, viruses or toxins and having a capacity of 1 cubic meter or greater.

7013. Materials.

Biological Weapon Agents

1. Human pathogens, as follows:

Note:

Except where the agent is in the form of a vaccine.

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. Bartonella Qintana (Rickettsiae quintana, Rochalimea quintana);
   3. Rickettsiae prowazeki;
   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. Burkholderia Mallei (Pseudomonas mallei);
   9. Burkholderia pseudomallei (Pseudomonas pseudo-mallei);
   10. Salmonella typhi;
   11. Shigella dysenteriae;
   12. Vibrio cholerae;
   13. Yersinia pestis;

d. Genetically Modified Microorganisms:
   1. Genetically modified microorganisms 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 microorganisms or genetic elements that contain nucleic acid sequences coding for any of the human toxins in the list below;

   Technical Note:

   Genetic elements include inter alia chromosomes, genomes, plasmids, transposons, and vectors whethergenetically modified or unmodified

e. Toxins:

   Note:

   Excluding Immunotoxins.

   1. Botulinum toxins;
   2. Clostridium perfringens toxins;
   3. Conotoxin;
   4. Shiga toxin;
   5. Staphylococcus aureus toxins;
   6. Tetrodotoxin;
   7. Verotoxin;
   8. Microcystin (Cyanginosin);
   9. Aflatoxins.

2. Animal pathogens, as follows:

Note:

Except where the agent is in the form of a vaccine.

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 haemegglutinin.

   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);

7013.2.a. con't.

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 microorganisms or genetic elements that contain nucleic acid sequences associated with pathogenicity and are derived from organisms in the above list of animal pathogens.
   Technical Note:
   Genetic elements include, inter alia, chromosomes, genomes, plasmids, transposous and vectors whether genetically modified or unmodified.

3. Plant Pathogens, as follows:

a. Virus B none;

b. Rickettsiae B none;

c. Bacteria:
   1. Xanthomonas albilineans;
   2. Xanthomonas campestris pv citri;

d. Genetically modified microorganisms or genetic elements that contain nucleic acid sequences associated with pathogenicity derived from the plant pathogens identified on this list;
   Technical Note:
   Genetic elements include inter alia chromosomes, genomes, plasmids, transposons, and vectors whethergenetically modified or unmodified

e. Toxins B none;

f. Fungi:
   1. Colletotrichum coffeanum var. virulans (Colletotrichum kahawae);
   2. Cochliobulus 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.

Note:
Governments may permit the shipment of medical products specifically packaged and marketed:

1. *For medical or public health purposes.*
2. *For irreversibly inactivated botulinum toxins in product form meeting all of the following criteria when they are:*
   a. *pharmaceutical formulations designed for human administration in the treatment of medical conditions;*
   b. *pre-packaged for distribution as medical products;*
   c. *authorised by a state authority to be marketed as medical products.*

(Item 7012. And 7013. apply to all destinations ***except*** *Argentina, Australia, Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Republic of Korea, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Slovak Republic, Spain, Sweden, Switzerland, United Kingdom and United States.)*

7014. Software:

None.

7015. Technology:

None.

Group 7 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.

"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 it's further dessemination. (copyright restrictions do not remove technology from being in the public domain)

"Production"
Means all production phases such as: construction, production engineering, manufacture, integration, assembly (mounting), inspection, testing, quality assurance.

"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, road-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".

"Use"
Operation, installation (including on-site installation), maintenance (checking), repair, overhaul and refurbishing.

Group 8 – Chemicals for the Production of Illicit Drugs

8011. Chemicals in excess of the indicated quantities, as follows:

1. Ephedrine (1 kg) *(all destinations)*;
2. Ergometrine (10 g);
3. Ergotamine (10 g);
4. Lysergic acid (10 g);
5. 1-phenyl-2-propanone (20 kg);
6. Pseudoephedrine (1 kg) (all destinations);
7. N-Acetylanthranilic acid (40 kg);
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);
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 keytone (2000 l);
4. Toluene (2000 l);
5. Potassium permanganate (500 kg);
6. Sulfuric acid (2000 l);
7. Hydrochloric acid (2000 l);
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.

Index

This non-exhaustive index is provided as a guide only.

Notes

Notes

Notes

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 1a.: 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 1b.: 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 Harmonised 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 seqentially 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 **DEPARTMENTAL USE ONLY.**

REMEMBER TO SIGN THE APPLICATION FORM

INCOMPLETE OR IMPROPERLY COMPLETED FORMS WILL BE RETURNED WITHOUT ACTION

External Affairs and International Trade Canada | Affaires extérieures et Commerce extérieur Canada

APPLICATION FOR PERMIT TO EXPORT GOODS
DEMANDE DE LICENCE D'EXPORTATION DE MARCHANDISES

(PLEASE PRINT OR TYPE/S.V.P. IMPRIMER OU DACTYLOGRAPHIER)

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

Name/Nom:

Address/Adresse:

City/Ville: | Province: | Country/Pays:

Postal Code/Code postal: | Telephone No./N° de téléphone: ( ) | Facsimilier/Télécopieur ( )

Contact/Responsable:

APPLICANT (if other than exporter)/REQUÉRANT (si autre que l'exportateur)

Name/Nom:

Address/Adresse:

City/Ville: | Province: | Country/Pays:

Postal Code/Code postal: | Telephone No./N° de téléphone: ( ) | Facsimilier/Télécopieur ( )

Contact/Responsable:

CONSIGNEE(S) AT FINAL DESTINATION / DESTINATAIRE(S) ULTIME(S)

Maximum three / maximum trois

1. Name/Nom:
   Address/Adresse: | City/Ville:
   Country of Final Destination/ Pays de destination finale:
2. Name/Nom:
   Address/Adresse: | City/Ville:
   Country of Final Destination/ Pays de destination finale:
3. Name/Nom:
   Address/Adresse: | City/Ville:
   Country of Final Destination/ Pays de destination finale:

CANADIAN PORT WHERE CUSTOMS EXPORT DECLARATION FORM WILL BE PRESENTED
PORT CANADIEN OÙ SERA PRÉSENTÉE LA FORMULE DE DÉCLARATION D'EXPORTATION

% 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	DESCRIPTION	Total Quantity / Quantité Totale	Unit Value / Valeur unitaire	Total Value / Valeur Totale ($ Can)	Approx. Net Wgt./ Poids net approx.
Col. 1(A)	Col. 1(B)	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							

THE TOTAL VALUE OF ALL GOODS PROPOSED FOR EXPORT AGAINST THIS APPLICATION IS: ($ CAN)
LA VALEUR TOTALE DE TOUTES LES MARCHANDISES À EXPORTER VISÉES PAR CETTE DEMANDE: ($ CAN)

$

ADDITIONAL INFORMATION ATTACHED
RENSEIGNEMENTS COMPLÉMENTAIRES CI-JOINT

IIC/EUC CII/CUF — Yes/Oui ☐ No/Non ☐

Technical Information / Description Renseignement / Description Technique — Yes/Oui ☐ No/Non ☐

PERMIT TO BE SENT TO / LICENCE À ENVOYER À: Exporter/Exportateur ☐ Applicant/Requérant ☐

By/Par: Mail/Poste ☐ Hold for Pickup/Retenue pour ramassage ☐ Courier Collect/Messagerie (port dû) ☐

CERTIFICATION

The undersigned hereby certifies that:
1. All information given in this form is true and correct.
2. The applicant is a resident of Canada.

ATTESTATION

Le soussigné certifie que:
1. Tous les renseignements donnés dans cette formule sont exacts:
2. Le requérant est un résident du Canada.

Signature _____ Date _____

FOR DEPARTMENTAL USE ONLY - À USAGE DU MINISTÈRE SEULEMENT

PERMIT
1. The export of goods described above is permitted subject to all conditions described herein in accordance with the Export and Import Permits Act and any regulations made thereunder.
2. This permit is valid only for use of the applicant or indicated exporter.
3. Export documents must agree with this permit.

LICENCE
1. L'exportation des marchandises décrites ci-dessus est autorisée sous réserve des conditions indiquées aux présentes conformément à la Loi et au Règlement sur les licences d'exportation et d'importation.
2. Cette licence ne peut être utilisée que par le requérant ou l'exportateur indiqué.
3. Les documents d'exportation doivent être conformes à cette licence.

for Secretary of State for External Affairs/pour le Secrétaire d'État aux Affaires extérieures

Permit Number: / N° de la licence:

Date of issue / Date d'émission:

Expiry Date: / Date d'expiration:

Expiry Date Extended to: / Date d'expiration prolongée au:

File Number: / N° du dossier:

Date of Receipt/ Date de réception

Send completed applications to/Soumettre les demandes complétées à:
Export Controls Division (EPE)/Direction du contrôle des exportations(EPE)
External Affairs and International Trade/Affaires extérieure et Commerce extérieur
P.O. Box 481, Station A/C.P. 481, Succursale "A"
Ottawa, Ontario
K1N 9K6

DISTRIBUTION: **WHITE/BLANC** - Departmental copy (Legal)/Copie ministérielle (Juridique) **YELLOW/JAUNE** - Exporter's copy (To be presented to customs at port of validation)/Copie de l'exportateur (Présenter aux douanes au port de validation) **PINK/ROSE** - Departmental copy (Working)/Copie ministérielle (Document de travail) **GREEN/VERT** - Departmental copy (To be returned to AECB when necessary)/Copie du ministère (Retourner à CCEA si nécessaire) **WHITE/BLANC** - Applicants file copy (To be kept by the applicant)/Copie du requérant (À retenir par le requérant)

EXT 1042 (09/93)

April 2002

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:*

Vancouver
International Trade Centre
2000 - 300 West Georgia Street
Vancouver, British Columbia
V6B 6E1

Tel: (604) 666-0434
Fax: (604) 666-0954

Edmonton
International Trade Centre
Canada Place
725 - 9700 Jasper Avenue
Edmonton, Alberta
T5J 4C3

Tel: (780) 495-2944
Fax: (780) 495-4507

Calgary
International Trade Centre
11th floor
400,639 - 5th Avenue S.W.
Calgary, Alberta
T5P 0M9

Tel: (403) 292-4575
Fax: (403) 292-4278

Saskatoon
International Trade Centre
7th Floor
123-2nd Avenue South
Saskatoon, Saskatchewan
S7K 7E6

Tel: (306) 975-5315
Fax: (306) 975-5334

Regina
International Trade Centre
320-1801 Hamilton Street
Regina, Saskatchewan
S4P 3N8

Tel: (306) 780-6124
Fax: (306) 780-8797

Winnipeg
International Trade Centre
4th Floor
400 St. Mary Avenue
Winnipeg, Manitoba
R3C 4K5

Tel: (204) 983-5851
Fax: (204) 983-3182

Toronto
International Trade Centre
Dominion Public Building
4th Floor, 151 Yonge Street
Toronto, Ontario
M5C 2W7

Tel: (416) 973-5053
Fax: (416) 973-8161

Ottawa
Foreign Affairs and International Trade Canada
Export Controls Division
125 Sussex Drive, C-6
P.O. Box 481, Station "A"
Ottawa, Ontario
K1N 9K6

Tel: (613) 996-2387
Fax: (613) 996-9933

Montreal
International Trade Centre
Tour de la Bourse
5 Place Ville-Marie, Suite 700
Montreal, Quebec
H3B 2G2

Tel: (514) 283-6328
Fax: (514) 283-8794

Moncton
International Trade Centre
1045 Main Street
Unit 103
Moncton, New Brunswick
E1C 1H1

Tel: (506) 851-6452
Fax: (506) 851-6429

Halifax
International Trade Centre
5th Floor
1800 Argyle Street
P.O. Box 940, Station "M"
Halifax, Nova Scotia
B2J 2V9

Tel: (902) 426-7540
Fax: (902) 426-5218

Charlottetown
International Trade Centre
100 Sydney Street
PO Box 40
Charlottetown, Prince Edward Island
C1A 7K2

Tel: (902) 566-7382
Fax: (902) 566-7098

St. John's
International Trade Centre
John Cabot building, 10th floor
10 Barter's Hill
St. John's, Newfoundland
A1B 3R9

Tel: (709) 772-5511
Fax: (709) 772-5093