5.8.5. 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 vapor, such as yttria-coated graphite or tantalum.

5.8.6. 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.

EXPLANATORY NOTE

These housings have a multiplicity of ports for electrical feed-throughs, diffusion pump connections and instrumentation diagnostics and monitoring. They have provisions for opening and closure to allow for refurbishment of internal components and are constructed of a suitable non-magnetic material such as stainless steel.

5.9. Especially designed or prepared systems, equipment and components for use in electromagnetic enrichment plants.

INTRODUCTORY NOTE

In the electromagnetic process, uranium metal ions produced by ionization of a salt feed material (typically UCl_4) are accelerated and passed through a magnetic field that has the effect of causing the ions of different isotopes to follow different paths. The major components of an electromagnetic isotope separator include: a magnetic field for ion-beam diversion/separation of the isotopes, an ion source with its acceleration system, and a collection system for the separated ions. Auxiliary systems for the process include the magnet power supply system, the ion source high-voltage power supply system, the vacuum system, and extensive chemical handling systems for recovery of product and cleaning/recycling of components.

5.9.1. Electromagnetic isotope separators

Electromagnetic isotope separators especially designed or prepared for the separation of uranium isotopes, and equipment and components therefor, including:

(a) Ion sources

Especially designed or prepared single or multiple uranium ion sources consisting of a vapor source, ionizer, 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.

(b) 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.

(c) 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.

EXPLANATORY NOTE

The housings are specially designed to contain the ion sources, collector plates and water-cooled liners and have provision for diffusion pump connections and opening and closure for removal and reinstallation of these components.

(d) 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.

5.9.2. 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.

5.9.3. 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.

6. Plants for the production or concentration of heavy water, deuterium and deuterium compounds and equipment especially designed or prepared therefor

INTRODUCTORY NOTE

Heavy water can be produced by a variety of processes. However, the two processes that have proven to be commercially viable are the water-hydrogen sulphide exchange process (GS process) and the ammonia-hydrogen exchange process.

The GS process is based upon the exchange of hydrogen and deuterium between water and hydrogen sulphide within a series of towers which are operated with the top section cold and the bottom section hot. Water flows down the towers while the hydrogen sulphide gas circulates from the bottom to the top of the towers. A series of perforated trays are used to promote mixing between the gas and the water. Deuterium migrates to the water at low temperatures and to the hydrogen sulphide at high temperatures. Gas or water, enriched in deuterium, is removed from the first stage towers at the junction of the hot and cold sections and the process is repeated in subsequent stage towers. The product of the last stage, water enriched up to 30% in deuterium, is sent to a distillation unit to produce reactor grade heavy water; i.e., 99.75% deuterium oxide.

The ammonia-hydrogen exchange process can extract deuterium from synthesis gas through contact with liquid ammonia in the presence of a catalyst. The synthesis gas is fed into exchange towers and to an ammonia converter. Inside the towers the gas flows from the bottom to the top while the liquid ammonia flows from the top to the bottom. The deuterium is stripped from the hydrogen in the synthesis gas and concentrated in the ammonia. The ammonia then flows into an ammonia cracker at the bottom of the tower while the gas flows into an ammonia converter at the top. Further enrichment takes place in subsequent stages and reactor grade heavy water is produced through final distillation. The synthesis gas feed can be provided by an ammonia plant that, in turn, can be constructed in association with a heavy water ammonia-hydrogen exchange plant. The ammonia-hydrogen exchange process can also use ordinary water as a feed source of deuterium.

Many of the key equipment items for heavy water production plants using GS or the ammonia-hydrogen exchange processes are common to several segments of the chemical and petroleum industries. This is particularly so for small plants using the GS process. However, few of the items are available "off-the-shelf". The GS and ammonia-hydrogen processes require the handling of large quantities of flammable, corrosive and toxic fluids at elevated pressures. Accordingly, in establishing the design and operating standards for plants and equipment using these processes, careful attention to the materials selection and specifications is required to ensure long service life with high safety and reliability factors. The choice of scale is primarily a function of economics and need. Thus, most of the equipment items would be prepared according to the requirements of the customer.

Finally, it should be noted that, in both the GS and the ammonia-hydrogen exchange processes, items of equipment which individually are not especially designed or prepared for heavy water production can be assembled into systems which are especially designed or prepared for producing heavy water. The catalyst production

system used in the ammonia-hydrogen exchange process and water distillation systems used for the final concentration of heavy water to reactor-grade in either process are examples of such systems.

The items of equipment which are especially designed or prepared for the production of heavy water utilizing either the water-hydrogen sulphide exchange process or the ammonia-hydrogen exchange process include the following:

6.1. 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.

6.2. 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/second (120,000 SCFM) while operating at pressures greater than or equal to 1.8 MPa (260 psi) suction and have seals designed for wet H_2S service.

6.3. 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 (2225 psi) especially designed or prepared for heavy water production utilizing the ammonia-hydrogen exchange process. These towers also have at least one flanged, axial opening of the same diameter as the cylindrical part through which the tower internals can be inserted or withdrawn.

6.4. 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.

6.5. 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.

6.6. Infrared Absorption Analyzers

Infrared absorption analyzers capable of "on-line" hydrogen/deuterium ratio analysis where deuterium concentrations are equal to or greater than 90%.

6.7. 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.

6.8. Complete heavy water upgrade systems or columns therefor

Complete heavy water upgrade systems, or columns therefor, especially designed or prepared for the upgrade of heavy water to reactor-grade deuterium concentration.

EXPLANATORY NOTE

These systems, which usually employ water distillation to separate heavy water from light water, are especially designed or prepared to produce reactor-grade heavy water (i.e., typically 99.75% deuterium oxide) from heavy water feedstock of lesser concentration.

7. 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 sections 4 and 5 respectively, and equipment especially designed or prepared therefor

EXPORTS

The export of the whole set of major items within this boundary will take place only in accordance with the procedures of the Guidelines. All of the plants, systems, and especially designed or prepared equipment within this boundary can be used for the processing, production, or use of special fissionable material.

7.1. Plants for the conversion of uranium and equipment especially designed or prepared therefor

INTRODUCTORY NOTE

Uranium conversion plants and systems may perform one or more transformations from one uranium chemical species to another, including: conversion of uranium ore concentrates to UO_3, conversion of UO_3 to UO_2, conversion of uranium oxides to UF_4, UF_6, or UCl_4, conversion of UF_4 to UF_6, conversion of UF_6 to UF_4, conversion of UF_4 to uranium metal, and conversion of uranium fluorides to UO_2. Many of the key equipment items for uranium conversion plants are common to several segments of the chemical process industry. For example, the types of equipment employed in these processes may include: furnaces, rotary kilns, fluidized bed reactors, flame tower reactors, liquid centrifuges, distillation columns and liquid-liquid extraction columns. However, few of the items are available "off-the-shelf"; most would be prepared according to the requirements and specifications of the customer. In some instances, special design and construction considerations are required to address the corrosive properties of some of the chemicals handled (HF, F_2, ClF_3, and uranium fluorides) as well as nuclear criticality concerns. Finally, it should be noted that, in all of the uranium conversion processes, items of equipment which individually are not especially designed or prepared for uranium conversion can be assembled into systems which are especially designed or prepared for use in uranium conversion.

7.1.1. Especially designed or prepared systems for the conversion of uranium ore concentrates to UO_3

EXPLANATORY NOTE

Conversion of uranium ore concentrates to UO_3 can be performed by first dissolving the ore in nitric acid and extracting purified uranyl nitrate using a solvent such as tributyl phosphate. Next, the uranyl nitrate is converted to UO_3 either by concentration and denitration or by neutralization with gaseous ammonia to produce ammounium diuranate with subsequent filtering, drying, and calcining.

7.1.2. Especially designed or prepared systems for the conversion of UO_3 to UF_6

EXPLANATORY NOTE

Conversion of UO_3 to UF_6 can be performed directly by fluorination. The process requires a source of fluorine gas or chlorine trifluoride.

7.1.3. Especially designed or prepared systems for the conversion of UO_3 to UO_2

EXPLANATORY NOTE

Conversion of UO_3 to UO_2 can be performed through reduction of UO_3 with cracked ammonia gas or hydrogen.

7.1.4. Especially designed or prepared systems for the conversion of UO_2 to UF_4

EXPLANATORY NOTE

Conversion of UO_2 to UF_4 can be performed by reacting UO_2 with hydrogen fluoride gas (HF) at 300-500°C.

7.1.5. Especially designed or prepared systems for the conversion of UF_4 to UF_6

EXPLANATORY NOTE

Conversion of UF_4 to UF_6 is performed by exothermic reaction with fluorine in a tower reactor. UF_6 is condensed from the hot effluent gases by passing the effluent stream through a cold trap cooled to -10°C. The process requires a source of fluorine gas.

7.1.6. Especially designed or prepared systems for the conversion of UF_4 to U metal

EXPLANATORY NOTE

Conversion of UF_4 to U metal is performed by reduction with magnesium (large batches) or calcium (small batches). The reaction is carried out at temperatures above the melting point of uranium (1130 °C).

7.1.7. Especially designed or prepared systems for the conversion of UF_6 to UO_2

EXPLANATORY NOTE

Conversion of UF_6 to UO_2 can be performed by one of three processes. In the first, UF_6 is reduced and hydrolyzed to UO_2 using hydrogen and steam. In the second, UF_6 is hydrolyzed by solution in water, ammonia is added to precipitate ammonium diuranate, and the diuranate is reduced to UO_2 with hydrogen at 820°C. In the third process, gaseous UF_6, CO_2, and NH_3 are combined in water, precipitating ammonium uranyl carbonate. The ammonium uranyl carbonate is combined with steam and hydrogen at 500-600°C to yield UO_2 .

UF_6 to UO_2 conversion is often performed as the first stage of a fuel fabrication plant.

7.1.8. Especially designed or prepared systems for the conversion of UF_6 to UF_4

EXPLANATORY NOTE

Conversion of UF_6 to UF_4 is performed by reduction with hydrogen.

7.1.9. Especially designed or prepared systems for the conversion of UO_2 to UCl_4

EXPLANATORY NOTE

Conversion of UO_2 to UCl_4 can be performed by one of two processes. In the first, UO_2 is reacted with carbon tetrachloride (CCl_4) at approximately 400°C. In the second, UO_2 is reacted at approximately 700°C in the presence of carbon black (CAS 1333-86-4), carbon monoxide, and chlorine to yield UCl_4.

7.2. Plants for the conversion of plutonium and equipment especially designed or prepared therefor

INTRODUCTORY NOTE

Plutonium conversion plants and systems perform one or more transformations from one plutonium chemical species to another, including: conversion of plutonium nitrate to PuO_2, conversion of PuO_2 to PuF_4, and conversion of PuF_4 to plutonium metal. Plutonium conversion plants are usually associated with reprocessing facilities, but may also be associated with plutonium fuel fabrication facilities. Many of the key equipment items for plutonium conversion plants are common to several segments of the chemical process industry. For example, the types of equipment employed in these processes may include: furnaces, rotary kilns, fluidized bed reactors, flame tower reactors, liquid centrifuges, distillation columns and liquid-liquid extraction columns. Hot cells, glove boxes and remote manipulators may also be required. However, few of the items are available "off-the-shelf"; most would be prepared according to the requirements and specifications of the customer. Particular care in designing for the special radiological, toxicity and criticality hazards associated with plutonium is essential. In some instances, special design and construction considerations are required to address the corrosive properties of some of the chemicals handled (e.g. HF). Finally, it should be noted that, for all plutonium conversion processes, items of equipment which individually are not especially designed or prepared for plutonium conversion can be assembled into systems which are especially designed or prepared for use in plutonium conversion.

7.2.1. Especially designed or prepared systems for the conversion of plutonium nitrate to oxide

EXPLANATORY NOTE

The main functions involved in this process are: process feed storage and adjustment, precipitation and solid/liquor separation, calcination, product handling, ventilation, waste management, and process control. The process systems are particularly adapted

so as to avoid criticality and radiation effects and to minimize toxicity hazards. In most reprocessing facilities, this process involves the conversion of plutonium nitrate to plutonium dioxide. Other processes can involve the precipitation of plutonium oxalate or plutonium peroxide.

7.2.2. Especially designed or prepared systems for plutonium metal production

EXPLANATORY NOTE

This process usually involves the fluorination of plutonium dioxide, normally with highly corrosive hydrogen fluoride, to produce plutonium fluoride which is subsequently reduced using high purity calcium metal to produce metallic plutonium and a calcium fluoride slag. The main functions involved in this process are fluorination (e.g. involving equipment fabricated or lined with a precious metal), metal reduction (e.g. employing ceramic crucibles), slag recovery, product handling, ventilation, waste management and process control. The process systems are particularly adapted so as to avoid criticality and radiation effects and to minimize toxicity hazards. Other processes include the fluorination of plutonium oxalate or plutonium peroxide followed by a reduction to metal.

ANNEX C

CRITERIA FOR LEVELS OF PHYSICAL PROTECTION

1. The purpose of physical protection of nuclear materials is to prevent unauthorized use and handling of these materials. Paragraph 3(a) of the Guidelines document calls for agreement among suppliers on the levels of protection to be ensured in relation to the type of materials, and equipment and facilities containing these materials, taking account of international recommendations.

2. Paragraph 3(b) of the Guidelines document states that implementation of measures of physical protection in the recipient country is the responsibility of the Government of that country. However, the levels of physical protection on which these measures have to be based should be the subject of an agreement between supplier and recipient. In this context these requirements should apply to all States.

3. The document INFCIRC/225 of the International Atomic Energy Agency entitled "The Physical Protection of Nuclear Material" and similar documents which from time to time are prepared by international groups of experts and updated as appropriate to account for changes in the state of the art and state of knowledge with regard to physical protection of nuclear material are a useful basis for guiding recipient States in designing a system of physical protection measures and procedures.

4. The categorization of nuclear material presented in the attached table or as it may be updated from time to time by mutual agreement of suppliers shall serve as the agreed basis for designating specific levels of physical protection in relation to the type of materials, and equipment and facilities containing these materials, pursuant to paragraph 3(a) and 3(b) of the Guidelines document.

5. The agreed levels of physical protection to be ensured by the competent national authorities in the use, storage and transportation of the materials listed in the attached table shall as a minimum include protection characteristics as follows:

CATEGORY III

Use and Storage within an area to which access in controlled.

Transportation under special precautions including prior arrangements among sender, recipient and carrier, and prior agreement between entities subject to the jurisdiction and regulation of supplier and recipient States, respectively, in case of international transport, specifying time, place and procedures for transferring transport responsibility.

CATEGORY II

Use and Storage within a protected area to which access is controlled, i.e., an area under constant surveillance by guards or electronic devices, surrounded by a physical barrier with a limited number of points of entry under appropriate control, or any area with an equivalent level of physical protection.

Transportation under special precautions including prior arrangements among sender, recipient, and carrier, and prior agreement between entities subject to the jurisdiction and regulation of supplier and recipient States, respectively, in case of international transport, specifying time, place and procedures for transferring transport responsibility.

CATEGORY I

Materials in this category shall be protected with highly reliable systems against unauthorized use as follows:

Use and storage within a highly protected area, i.e., a protected area as defined for Category II above, to which, in addition, access is restricted to person whose trustworthiness has been determined, and which is under surveillance by guards who are in close communication with appropriate response forces. Specific measures taken in this context should have as their objective the detection and prevention of any assault, unauthorized access or unauthorized removal of material.

Transportation under special precautions as identified above for transportation of Category II and III materials and, in addition, under constant surveillance by escorts and under conditions which assure close communication with appropriate response forces.

6. Suppliers should request identification by recipients of those agencies or authorities having responsibility for ensuring that levels of protection are adequately met and having responsibility for internally co-ordinating response/recovery operations in the event of unauthorized use or handling of protected materials. Suppliers and recipients should also designate points of contact within their national authorities to co-operate on matters of out-of-country transportation and other matters of mutual concern.

TABLE: CATEGORIZATION OF NUCLEAR MATERIAL

Material	Form	Category I	Category II	Category III
1. Plutonium*[a]	Unirradiated*[b]	2 kg or more	Less than 2 kg but more than 500 g	500 g or less*[c]
2. Uranium-235	Unirradiated*[b]			
	- uranium enriched to 20% ^{235}U or more	5 kg or more	Less than 5 kg but more than 1 kg	1 kg or less*[c]
	- uranium enriched to 10% ^{235}U but less than 20%	-	10 kg or more	Less than 10 kg*[c]
	- uranium enriched above natural, but less than 10% ^{235}U*[d]	-	-	10 kg or more
3. Uranium-233	Unirradiated*[b]	2 kg or more	Less than 2 kg but more than 500 g	500 g or less*[c]
4. Irradiated fuel			Depleted or natural uranium, thorium or low-enriched fuel (less than 10% fissile content)*[e][f]	

[a] As identified in the Trigger List.

[b] Material not irradiated in a reactor or material irradiated in a reactor but with a radiation level equal to or less than 100 rads/hour at one metre unshielded.

[c] Less than a radiologically significant quantity should be exempted.

[d] Natural uranium, depleted uranium, and thorium and quantities of uranium enriched to less than 10% not falling in Category III should be protected in accordance with prudent management practice.

[e] Although this level of protection is recommended, it would be open to States, upon evaluation of the specific circumstances, to assign a different category of physical protection.

[f] Other fuel which by virtue of its original fissile material content is classified as Category I or II before irradiation may be reduced one category levels while the radiation level from the fuel exceed 100 rads/hour at tone metre unshielded.

Comparison Table of Changes to the Guidelines for Nuclear Transfers (INFCIRC/254/Part 1)

Old (Revision 8)	New (Revision 9)
	Annex A – General Note **3. Suppliers recognize the close relationship for certain isotope separation processes between plants, equipment and technology for uranium enrichment and that for the separation of stable isotopes for research, medical and other non-nuclear industrial purposes. In that regard, suppliers should carefully review their legal measures, including export licensing regulations and information/technology classification and security practices, for stable isotope separation activities to ensure the implementation of appropriate protection measures as warranted. Suppliers recognize that, in particular cases, appropriate protection measures for stable isotope separation activities will be essentially the same as those for uranium enrichment. (See Introductory Note in Section 5 of the Trigger List.) In accordance with Paragraph 16(a) of the Guidelines, suppliers shall consult with other suppliers as appropriate, in order to promote uniform policies and procedures in the transfer and protection of stable isotope separation plants, equipment and technology.**
Annex A 2.5. Plants for the separation of isotopes of uranium and equipment, other than analytical instruments, especially designed or prepared therefor (see Annex B, section 5.);	**Annex A** 2.5. Plants for the separation of isotopes of **natural** uranium, **depleted uranium or special fissionable material** and equipment, other than analytical instruments, especially designed or prepared therefor (see Annex B, section 5.);

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November 2007

Annex B 5. Plants for the separation of isotopes of uranium and equipment, other than analytical instruments, especially designed or prepared therefor	**Annex B** 5. Plants for the separation of isotopes of **natural** uranium, **depleted uranium or special fissionable material** and equipment, other than analytical instruments, especially designed or prepared therefor
	Annex B, Section 5 **INTRODUCTORY NOTE** **Plants, equipment and technology for the separation of uranium isotopes have, in many instances, a close relationship to plants, equipment and technology for the separation of stable isotopes. In particular cases, the controls under Section 5 also apply accordingly to plants and equipment that are intended for the separation of stable isotopes. These controls of plants and equipment for the separation of stable isotopes are complementary to controls on plants and equipment especially designed or prepared for the processing, use or production of special fissionable material covered by the Trigger List. These complementary Section 5 controls for stable isotope uses do not apply to the electromagnetic isotope separation process, which is addressed under Part 2 of the Guidelines.** **Processes for which the controls in Section 5 equally apply whether the intended use is uranium isotope separation or stable isotope separation are: gas centrifuge, gaseous diffusion, the plasma separation process, and aerodynamic processes.** **For some processes, the relationship to uranium isotope separation depends on the element (stable isotope) being separated. These processes are: laser-based processes**

	(e.g., molecular laser isotope separation and atomic vapor laser isotope separation), chemical exchange, and ion exchange. Suppliers must therefore evaluate these processes on a case-by-case basis to apply Section 5 controls for stable isotope uses accordingly.
	Annex B **5.2.3 Special shut-off and control valves** **Especially designed or prepared bellows-sealed valves, manual or automated, shut-off or control, made of or protected by materials resistant to corrosion by UF_6, with a diameter of 10 to 160 mm, for use in main or auxiliary systems of gas centrifuge enrichment plants.**
5.2.3.	5.2.**4**.
5.2.4.	5.2.**5**.

United Nations S/2009/205

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Letter dated 14 April 2009 from the Permanent Representative of the United States of America to the United Nations addressed to the President of the Security Council

Please find attached a list of items, materials, equipment, goods and technology related to ballistic missile-related programmes (see annex). This list updates the list contained in the annex to the document S/2006/815 and may be useful for discussions related to the Presidential Statement of 13 April 2009 (S/PRST/2009/7) regarding the Democratic People's Republic of Korea.

I would be grateful if you would make the necessary arrangements for the present letter and its annex to be issued as a document of the Security Council.

(*Signed*) Susan E. **Rice**
Ambassador

09-30344 (E) 270409

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Annex to the letter dated 14 April 2009 from the Permanent Representative of the United States of America to the United Nations addressed to the President of the Security Council

List of items, materials, equipment, goods and technology related to ballistic missile programmes

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15.B.1. Vibration test equipment
a. Vibration test systems
b. Digital controllers
c. Vibration thrusters (shaker units)
d. Test piece support structures and electronic units
15.B.2. Wind-tunnels
15.B.3. Test benches/stands
15.B.4. Environmental chambers
15.B.5. Accelerators
15.C. None
15.D.1. "Software"
15.E.1. "Technology"

CATEGORY II - ITEM 16
MODELLING-SIMULATION AND DESIGN INTEGRATION
16.A.1. Hybrid (combined analogue/digital) computers
16.B. None
16.C. None
16.D.1. "Software"
16.E.1. "Technology"

CATEGORY II - ITEM 17
STEALTH
17.A.1. Devices for reduced observables
17.B.1. Systems specially designed for radar cross section measurement
17.C.1. Materials for reduced observables
17.D.1. "Software"
17.E.1. "Technology"

CATEGORY II - ITEM 18
NUCLEAR EFFECTS PROTECTION
18.A.1. "Radiation Hardened" "microcircuits"
18.A.2. 'Detectors'
18.A.3. Radomes
18.B. None
18.C. None
18.D. None
18.E.1. "Technology"

CATEGORY II - ITEM 19
OTHER COMPLETE DELIVERY SYSTEMS
19.A.1. Other complete rocket systems (≥ 300km range)
19.A.2. Other complete UAV systems (≥ 300km range)
19.A 3. Other complete UAV systems
19.B. None
19.C. None
19.D.1. "Software"
19.E.1. "Technology"

CATEGORY II - ITEM 20
OTHER COMPLETE SUBSYSTEMS
20.A.1.a. Individual rocket stages
b.Solid propellant rocket motors or liquid propellant rocket engines
20.B.1. "Production facilities"
20.B.2. "Production equipment"
20.C. None
20.D.1 "Software"
20.D.2. "Software"
20.E.1. "Technology"

UNITS, CONSTANTS, ACRONYMS AND ABBREVIATIONS USED IN THIS ANNEX

TABLE OF CONVERSIONS

STATEMENT OF UNDERSTANDING

INTRODUCTION, DEFINITIONS, TERMINOLOGY

1. INTRODUCTION

(a) This Annex consists of two categories of items, which term includes equipment, materials, "software" or "technology". Category I items, all of which are in Annex Items 1 and 2, are those items of greatest sensitivity. If a Category I item is included in a system, that system will also be considered as Category I, except when the incorporated item cannot be separated, removed or duplicated. Category II items are those items in the Annex not designated Category I.

(b) In reviewing the proposed applications for transfers of complete rocket and unmanned aerial vehicle systems described in Items 1 and 19, and of equipment, materials, "software" or "technology" which is listed in the Technical Annex, for potential use in such systems, the Government will take account of the ability to trade off "range" and "payload".

(c) **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 authorizes the export to the same end-user of the minimum "technology" required for the installation, operation, maintenance, and repair of the item.

Note:

Controls do not apply to "technology" "in the public domain" or to "basic scientific research".

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(d) **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".

(e) **Chemical Abstracts Service (CAS) Numbers:**

In some instances chemicals are listed by name and CAS number. Chemicals of the same structural formula (including hydrates) are controlled regardless of name or CAS number. CAS numbers are shown to assist in identifying whether a particular chemical or mixture is controlled, irrespective of nomenclature. CAS numbers cannot be used as unique identifiers because some forms of the listed chemical have different CAS numbers, and mixtures containing a listed chemical may also have different CAS numbers.

INTRODUCTION, DEFINITIONS, TERMINOLOGY

2. DEFINITIONS

For the purpose of this Annex, the following definitions apply:

"Accuracy"
Usually measured in terms of inaccuracy, means the maximum deviation, positive or negative, of an indicated value from an accepted standard or true value.

"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. (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.

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"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.

"Payload"

The total mass that can be carried or delivered by the specified rocket system or unmanned aerial vehicle (UAV) system that is not used to maintain flight.

Note:

The particular equipment, subsystems, or components to be included in the "payload" depends on the type and configuration of the vehicle under consideration.

Technical Notes:

1. Ballistic Missiles

a. "Payload" for systems with separating re-entry vehicles (RVs) includes:
1. The RVs, including:
a. Dedicated guidance, navigation, and control equipment;
b. Dedicated countermeasures equipment;
2. Munitions of any type (e.g. explosive or non-explosive);
3. Supporting structures and deployment mechanisms for the munitions (e.g. hardware used to attach to, or separate the RV from, the bus/post-boost vehicle) that can be removed without violating the structural integrity of the vehicle;
4. Mechanisms and devices for safing, arming, fuzing or firing;
5. Any other countermeasures equipment (e.g. decoys, jammers or chaff dispensers) that separate from the RV bus/post-boost vehicle;
6. The bus/post-boost vehicle or attitude control/velocity trim module not including systems/subsystems essential to the operation of the other stages.

b. "Payload" for systems with non-separating re-entry vehicles includes:
1. Munitions of any type (e.g. explosive or non-explosive);
2. Supporting structures and deployment mechanisms for the munitions that can be removed without violating the structural integrity of the vehicle;

INTRODUCTION, DEFINITIONS, TERMINOLOGY

3. Mechanisms and devices for safing, arming, fuzing or firing;
4. Any countermeasures equipment (e.g. decoys, jammers or chaff dispensers) that can be removed without violating the structural integrity of the vehicle.

2. Space Launch Vehicles

"Payload" includes:
a. Satellites (single or multiple);
b. Satellite-to-launch vehicle adapters including, if applicable, apogee/perigee kick motors or similar manoeuvering systems.

3. Sounding Rockets

"Payload" includes:
a. Equipment required for a mission, such as data gathering, recording or transmitting devices for mission-specific data;
b. Recovery equipment (e.g. parachutes) that can be removed without violating the structural integrity of the vehicle.

4. Cruise Missiles

"Payload" includes:
a. Munitions of any type (e.g. explosive or non-explosive);
b. Supporting structures and deployment mechanisms for the munitions that can be removed without violating the structural integrity of the vehicle;
c. Mechanisms and devices for safing, arming, fuzing or firing;
d. Countermeasures equipment (e.g. decoys, jammers or chaff dispensers) that can be removed without violating the structural integrity of the vehicle;
e. Signature alteration equipment that can be removed without violating the structural integrity of the vehicle.

5. Other UAVs

"Payload" includes:
a. Munitions of any type (e.g. explosive or non-explosive);
b. Mechanisms and devices for safing, arming, fuzing or firing;

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c. Countermeasures equipment (e.g. decoys, jammers or chaff dispensers) that can be removed without violating the structural integrity of the vehicle;
d. Signature alteration equipment that can be removed without violating the structural integrity of the vehicle;
e. Equipment required for a mission such as data gathering, recording or transmitting devices for mission-specific data and supporting structures that can be removed without violating the structural integrity of the vehicle;
f. Recovery equipment (e.g. parachutes) that can be removed without violating the structural integrity of the vehicle.
g. Munitions supporting structures and deployment mechanisms that can be removed without violating the structural integrity of the vehicle.

"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 therefor, 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" therefor 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.

INTRODUCTION, DEFINITIONS, TERMINOLOGY

"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 5×10^5 rads (Si).

"Range"
The maximum distance that the specified rocket system or unmanned aerial vehicle (UAV) system is capable of travelling in the mode of stable flight as measured by the projection of its trajectory over the surface of the Earth.

Technical Notes:

1. The maximum capability based on the design characteristics of the system, when fully loaded with fuel or propellant, will be taken into consideration in determining "range".

2. The "range" for both rocket systems and UAV systems will be determined independently of any external factors such as operational restrictions, limitations imposed by telemetry, data links or other external constraints.

3. For rocket systems, the "range" will be determined using the trajectory that maximises "range", assuming ICAO standard atmosphere with zero wind.

4. For UAV systems, the "range" will be determined for a one-way distance using the most fuel-efficient flight profile (e.g. cruise speed and altitude), assuming ICAO standard atmosphere with zero wind.

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

"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".

"Technical assistance"
May take forms such as:
- instruction
- skills

INTRODUCTION, DEFINITIONS, TERMINOLOGY

- training
- working knowledge
- consulting services

"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

"Use"
Means:
- operation
- installation (including on-site installation)
- maintenance
- repair
- overhaul
- refurbishing

INTRODUCTION, DEFINITIONS, TERMINOLOGY

3. TERMINOLOGY

Where the following terms appear in the text, they are to be understood according to the explanations below:

(a) "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.

(b) "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.

(c) "Usable in", "usable for", "usable as" or "capable of" describes equipment, parts, components, materials or "software" which are suitable for a particular purpose. There is no need for the equipment, parts, components or "software" to have been configured, modified or specified for the particular purpose. For example, any military specification memory circuit would be "capable of" operation in a guidance system.

(d) "Modified" in the context of "software" describes "software" which has been intentionally changed such that it has properties that make it fit for specified purposes or applications. Its properties may also make it suitable for purposes or applications other than those for which it was "modified".

CATEGORY I; ITEM 1

CATEGORY I

ITEM 1 COMPLETE DELIVERY SYSTEMS

1.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

1.A.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.

1.A.2. Complete unmanned aerial 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.

1.B. TEST AND PRODUCTION EQUIPMENT

1.B.1. "Production facilities" specially designed for the systems specified in 1.A.

1.C. MATERIALS

None.

1.D. SOFTWARE

1.D.1. "Software" specially designed or modified for the "use" of "production facilities" specified in 1.B.

1.D.2. "Software" which coordinates the function of more than one subsystem, specially designed or modified for "use" in systems specified in 1.A.

1.E. TECHNOLOGY

1.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 1.A., 1.B., or 1.D.

CATEGORY I; ITEM 2

ITEM 2 COMPLETE SUBSYSTEMS USABLE FOR COMPLETE DELIVERY SYSTEMS

2.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

2.A.1. Complete subsystems usable in the systems specified in 1.A., as follows:

a. Individual rocket stages usable in the systems specified in 1.A.;

b. Re-entry vehicles, and equipment designed or modified therefor, usable in the systems specified in 1.A., as follows, except as provided in the Note below 2.A.1. for those designed for non-weapon payloads:
1. Heat shields, and components therefor, fabricated of ceramic or ablative materials;
2. Heat sinks and components therefor, 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 1.A., having a total impulse capacity equal to or greater than 1.1×10^6 Ns;

Note:
Liquid propellant apogee engines and station-keeping engines specified in 2.A.1.c., designed or modified for use on satellites, 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 a vacuum thrust not greater than 1kN.

d. 'Guidance sets', usable in the systems specified in 1.A., 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 the Note below 2.A.1. for those designed for missiles with a "range" under 300 km or manned aircraft;

CATEGORY I; ITEM 2

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.

e. Thrust vector control sub-systems, usable in the systems specified in 1.A., except as provided in the Note below 2.A.1. for those designed for rocket systems that do not exceed the "range"/"payload" capability of systems specified in 1.A.;

Technical Note:

2.A.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, fuzing, and firing mechanisms, usable in the systems specified in 1.A., except as provided in the Note below 2.A.1. for those designed for systems other than those specified in 1.A.

Note:

The exceptions in 2.A.1.b., 2.A.1.d., 2.A.1.e. and 2.A.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.

2.B. TEST AND PRODUCTION EQUIPMENT

2.B.1. "Production facilities" specially designed for the subsystems specified in 2.A.

CATEGORY I; ITEM 2

2.B.2. "Production equipment" specially designed for the subsystems specified in 2.A.

2.C. MATERIALS

None.

2.D. SOFTWARE

2.D.1. "Software" specially designed or modified for the "use" of "production facilities" specified in 2.B.1.

2.D.2. "Software" specially designed or modified for the "use" of rocket motors or engines specified in 2.A.1.c.

2.D.3. "Software", specially designed or modified for the "use" of 'guidance sets' specified in 2.A.1.d.

Note:

2.D.3. includes "software", specially designed or modified to enhance the performance of 'guidance sets' to achieve or exceed the accuracy specified in 2.A.1.d.

2.D.4. "Software" specially designed or modified for the "use" of subsystems or equipment specified in 2.A.1.b.3.

2.D.5. "Software" specially designed or modified for the "use" of systems in 2.A.1.e.

2.D.6. "Software" specially designed or modified for the "use" of systems in 2.A.1.f.

Note:

Subject to end-use statements appropriate for the excepted end-use, "software" controlled by 2.D.2. - 2.D.6. may be treated as Category II as follows:

1. Under 2.D.2. if specially designed or modified for liquid propellant apogee engines, designed or modified for satellite applications as specified in the Note to 2.A.1.c.:

CATEGORY I; ITEM 2

2. Under 2.D.3. if designed for missiles with a "range" of under 300 km or manned aircraft;

3. Under 2.D.4. if specially designed or modified for re-entry vehicles designed for non-weapon payloads;

4. Under 2.D.5. if designed for rocket systems that do not exceed the "range" "payload" capability of systems specified in 1.A.;

5. Under 2.D.6. if designed for systems other than those specified in 1.A.

2.E. TECHNOLOGY

2.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 2.A., 2.B. or 2.D.

CATEGORY II; ITEM 3

CATEGORY II

ITEM 3 PROPULSION COMPONENTS AND EQUIPMENT

3.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

3.A.1. Turbojet and turbofan engines (including turbocompound engines), 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 8.89 kN (achieved un-installed); and
2. Specific fuel consumption of 0.15 kg N^{-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 1.A. or 19.A.2., regardless of thrust or specific fuel consumption.

Note:

Engines specified in 3.A.1. may be exported as part of a manned aircraft or in quantities appropriate for replacement parts for a manned aircraft.

3.A.2. Ramjet/scramjet/pulse jet/combined cycle engines, including devices to regulate combustion, and specially designed components therefor, usable in the systems specified in 1.A. or 19.A.2.

3.A.3. Rocket motor cases, 'insulation' components and nozzles therefor, usable in the systems specified in 1.A. or 19.A.1.

Technical Note:

In 3.A.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.

CATEGORY II; ITEM 3

Note:

Refer to 3.C.2. for 'insulation' material in bulk or sheet form.

3.A.4. Staging mechanisms, separation mechanisms, and interstages therefor, usable in the systems specified in 1.A.

3.A.5. Liquid and slurry propellant (including oxidisers) control systems, and specially designed components therefor, usable in the systems specified in 1.A., designed or modified to operate in vibration environments greater than 10 g rms between 20 Hz and 2 kHz.

Notes:

1. The only servo valves and pumps specified in 3.A.5. are the following:
   a. Servo valves designed for flow rates equal to or greater than 24 litres per minute, at an absolute pressure equal to or greater than 7 MPa, 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 MPa.

2. Systems and components specified in 3.A.5. may be exported as part of a satellite.

3.A.6. Hybrid rocket motors and specially designed components therefor, usable in the systems specified in 1.A., 19.A.1. or 19.A.2.

3.A.7. Radial ball bearings having all tolerances specified in accordance with ISO 492 Tolerance Class 2 (or ANSI/ABMA Std 20 Tolerance Class ABEC-9 or other national equivalents), or better and having all the following characteristics:

a. An inner ring bore diameter between 12 and 50 mm;

b. An outer ring outside diameter between 25 and 100 mm; and

c. A width between 10 and 20 mm.

3.A.8. Liquid propellant tanks specially designed for the propellants controlled in Item 4.C. or other liquid propellants used in the systems specified in 1.A.1.

CATEGORY II; ITEM 3

3.A.9. 'Turboprop engine systems' specially designed for the systems in 1.A.2. or 19.A.2., and specially designed components therefor, having a maximum power greater than 10 kW (achieved uninstalled at sea level standard conditions), excluding civil certified engines.

Technical Note:

For the purposes of Item 3.A.9., a 'turboprop engine system' incorporates all of the following:
a. Turboshaft engine; and
b. Power transmission system to transfer the power to a propeller.

3.B. TEST AND PRODUCTION EQUIPMENT

3.B.1. "Production facilities" specially designed for equipment or materials specified in 3.A.1., 3.A.2., 3.A.3., 3.A.4., 3.A.5., 3.A.6., 3.A.8., 3.A.9. or 3.C.

3.B.2. "Production equipment" specially designed for equipment or materials specified in 3.A.1., 3.A.2., 3.A.3., 3.A.4., 3.A.5., 3.A.6., 3.A.8., 3.A.9. or 3.C.

3.B.3. Flow-forming machines, and specially designed components therefor, 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 1.A.

CATEGORY II; ITEM 3

3.C. MATERIALS

3.C.1. 'Interior lining' usable for rocket motor cases in the systems specified in 1.A. or specially designed for systems specified in 19.A.1. or 19.A.2.

Technical Note:

In 3.C.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.

3.C.2. 'Insulation' material in bulk form usable for rocket motor cases in the systems specified in 1.A. or specially designed for systems specified in 19.A.1. or 19.A.2.

Technical Note:

In 3.C.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 3.A.3.

3.D. SOFTWARE

3.D.1. "Software" specially designed or modified for the "use" of "production facilities" and flow forming machines specified in 3.B.1. or 3.B.3.

3.D.2. "Software" specially designed or modified for the "use" of equipment specified in 3.A.1., 3.A.2., 3.A.4., 3.A.5., 3.A.6. or 3.A.9.

Notes:

1. "Software" specially designed or modified for the "use" of engines specified in 3.A.1. may be exported as part of a manned aircraft or as replacement "software" therefor.

CATEGORY II; ITEM 3

2. "Software" specially designed or modified for the "use" of propellant control systems specified in 3.A.5. may be exported as part of a satellite or as replacement "software" therefor.

3.D.3. "Software" specially designed or modified for the "development" of equipment specified in 3.A.2., 3.A.3. or 3.A.4.

3.E. TECHNOLOGY

3.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment, materials or "software" specified in 3.A.1., 3.A.2., 3.A.3., 3.A.4., 3.A.5., 3.A.6., 3.A.9., 3.B., 3.C. or 3.D.

CATEGORY II; ITEM 4

ITEM 4 PROPELLANTS, CHEMICALS AND PROPELLANT PRODUCTION

4.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

None.

4.B. TEST AND PRODUCTION EQUIPMENT

4.B.1. "Production equipment", and specially designed components therefor, for the "production", handling or acceptance testing of liquid propellants or propellant constituents specified in 4.C.

4.B.2. "Production equipment", other than that described in 4.B.3., and specially designed components therefor, for the production, handling, mixing, curing, casting, pressing, machining, extruding or acceptance testing of solid propellants or propellant constituents specified in 4.C.

4.B.3. Equipment as follows, and specially designed components therefor:

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 a temperature control capability of the mixing chamber having any of the following:
1. Two or more mixing/kneading shafts; or
2. A single rotating shaft which oscillates and having kneading teeth/pins on the shaft as well as inside the casing of the mixing chamber;

c. Fluid energy mills usable for grinding or milling substances specified in 4.C.;

d. Metal powder "production equipment" usable for the "production", in a controlled environment, of spherical or atomised materials specified in 4.C.2.c., 4.C.2.d. or 4.C.2.e.

CATEGORY II; ITEM 4

Note:

4.B.3.d. includes:

a. Plasma generators (high frequency arc-jet) usable for obtaining sputtered or spherical metallic powders with organization of the process in an argon-water environment;

b. Electroburst equipment usable for obtaining sputtered or spherical metallic powders with organization of the process in an argon-water environment;

c. Equipment usable for the "production" of spherical aluminium 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 4.C., and fluid energy mills specified in 4.B., are those specified in 4.B.3.

2. Forms of metal powder "production equipment" not specified in 4.B.3.d. are to be evaluated in accordance with 4.B.2.

4.C. MATERIALS

4.C.1. Composite and composite modified double base propellants.

4.C.2. Fuel substances as follows:

a. Hydrazine (CAS 302-01-2) with a concentration of more than 70%;

b. Hydrazine derivatives as follows:

1. Monomethylhydrazine (MMH) (CAS 60-34-4);
2. Unsymmetrical dimethylhydrazine (UDMH) (CAS 57-14-7);
3. Hydrazine mononitrate;
4. Trimethylhydrazine (CAS 1741-01-1);
5. Tetramethylhydrazine (CAS 6415-12-9);
6. N,N diallylhydrazine;
7. Allylhydrazine (CAS 7422-78-8);
8. Ethylene dihydrazine;
9. Monomethylhydrazine dinitrate;
10. Unsymmetrical dimethylhydrazine nitrate;

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11. Hydrazinium azide (CAS 14546-44-2);
12. Dimethylhydrazinium azide;
13. Hydrazinium dinitrate;
14. Diimido oxalic acid dihydrazine;
15. 2-hydroxyethylhydrazine nitrate (HEHN);
16. Hydrazinium perchlorate (CAS 27978-54-7);
17. Hydrazinium diperchlorate;
18. Methylhydrazine nitrate (MHN);
19. Diethylhydrazine nitrate (DEHN);
20. 3,6-dihydrazino tetrazine nitrate (DHTN);

Technical note:

3,6-dihydrazino tetrazine nitrate is also referred to as 1,4-dihydrazine nitrate

c. Spherical aluminium powder (CAS 7429-90-5) with particles of uniform diameter of less than 200 x 10^{-6} m (200 µm) and an aluminium content of 97% by weight or more, if at least 10% of the total weight is made up of particles of less than 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 (CAS 7440-67-7), beryllium (CAS 7440-41-7), magnesium (CAS 7439-95-4) 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% by weight or more of any of the above mentioned metals;

Technical Note:

The natural content of hafnium (CAS 7440-58-6) in the zirconium (typically 2% to 7%) is counted with the zirconium.

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e. Boron (**CAS 7440-42-8**) and boron alloys in particle size less than 60×10^{-6} m (60 μm), whether spherical, atomised, spheroidal, flaked or ground with a purity of 85% by weight or more;

f. High energy density materials such as boron slurry, having an energy density of 40×10^{6} J/kg or greater.

4.C.3. Oxidisers/Fuels as follows:

Perchlorates, chlorates or chromates mixed with powdered metals or other high energy fuel components.

4.C.4. Oxidiser substances as follows:

a. Oxidiser substances usable in liquid propellant rocket engines as follows:
1. Dinitrogen trioxide (CAS 10544-73-7);
2. Nitrogen dioxide (CAS 10102-44-0) / dinitrogen tetroxide (CAS 10544-72-6);
3. Dinitrogen pentoxide (CAS 10102-03-1);
4. Mixed Oxides of Nitrogen (MON);
5. Inhibited Red Fuming Nitric Acid (IRFNA) (CAS 8007-58-7);
6. Compounds composed of fluorine and one or more of other halogens, oxygen or nitrogen;

Technical Note:

Mixed Oxides of Nitrogen (MON) are solutions of Nitric Oxide (NO) in Dinitrogen Tetroxide/Nitrogen Dioxide (N_2O_4/NO_2) that can be used in missile systems. There are a range of compositions that can be denoted as MONi or MONij where i and j are integers representing the percentage of Nitric Oxide in the mixture (e.g. MON3 contains 3% Nitric Oxide, MON25 25% Nitric Oxide. An upper limit is MON40, 40% by weight).

Note:

Item 4.C.4.a.6. does not control Nitrogen Trifluoride (NF_3) (CAS 7783-54-2) in a gaseous state as it is not usable for missile applications.

b. Oxidiser substances usable in solid propellant rocket motors as follows:
1. Ammonium perchlorate (AP) (CAS 7790-98-9);

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2. Ammonium dinitramide (ADN) (CAS 140456-78-6);
3. Nitro-amines (cyclotetramethylene - tetranitramine (HMX) (CAS 2691-41-0); cyclotrimethylene - trinitramine (RDX) (CAS 121-82-4);
4. Hydrazinium nitroformate (HNF) (CAS 20773-28-8);
5. 2,4,6,8,10,12-Hexanitrohexaazaisowurtzitane (CL-20) (CAS 135285-90-4).

4.C.5. Polymeric substances, as follows:

a. Carboxy - terminated polybutadiene (including carboxyl - terminated polybutadiene) (CTPB);

b. Hydroxy - terminated polybutadiene (including hydroxyl - terminated polybutadiene) (HTPB);

c. Glycidyl azide polymer (GAP);

d. Polybutadiene - Acrylic Acid (PBAA);

e. Polybutadiene - Acrylic Acid - Acrylonitrile (PBAN);

f. Polytetrahydrofuran polyethylene glycol (TPEG).

Technical Note:

Polytetrahydrofuran polyethylene glycol (TPEG) is a block co-polymer of poly 1,4-Butanediol and polyethylene glycol (PEG).

4.C.6. Other propellant additives and agents as follows:

a. Bonding agents as follows:
1. Tris (1-(2-methyl)aziridinyl) phosphine oxide (MAPO) (CAS 57-39-6);
2. 1,1',1"-trimesoyl-tris(2-ethylaziridine) (HX-868, BITA) (CAS 7722-73-8);
3. Tepanol (HX-878), reaction product of tetraethylenepentamine, acrylonitrile and glycidol (CAS 68412-46-4);
4. Tepan (HX-879), reaction product of tetraethylenepentamine and acrylonitrile (CAS 68412-45-3);

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5. Polyfunctional aziridine amides with isophthalic, trimesic, isocyanuric, or trimethyladipic backbone also having a 2-methyl or 2-ethyl aziridine group;

Note:

Item 4.C.6.a.5. includes:
1. *1,1'-Isophthaloyl-bis(2-methylaziridine) (HX-752) (CAS 7652-64-4);*
2. *2,4,6-tris(2-ethyl-1-aziridinyl)-1.3.5-triazine (HX-874) (CAS 18924-91-9);*
3. *1,1'-trimethyladipoylbis(2-ethylaziridine) (HX-877) (CAS 71463-62-2).*

b. Curing reaction catalysts as follows:
Triphenyl bismuth (TPB) (CAS 603-33-8);

c. Burning rate modifiers, as follows:
1. Carboranes, decaboranes, pentaboranes and derivatives thereof;
2. Ferrocene derivatives, as follows:
   a. Catocene (CAS 37206-42-1);
   b. Ethyl ferrocene (CAS 1273-89-8);
   c. Propyl ferrocene;
   d. n-Butyl ferrocene (CAS 31904-29-7);
   e. Pentyl ferrocene (CAS 1274-00-6);
   f. Dicyclopentyl ferrocene;
   g. Dicyclohexyl ferrocene;
   h. Diethyl ferrocene;
   i. Dipropyl ferrocene;
   j. Dibutyl ferrocene (CAS 1274-08-4);
   k. Dihexyl ferrocene (CAS 93894-59-8);
   l. Acetyl ferrocenes;
   m. Ferrocene Carboxylic acids;
   n. Butacene (CAS 125856-62-4);
   o. Other ferrocene derivatives usable as rocket propellant burning rate modifiers;

d. Esters and plasticisers as follows:
1. Triethylene glycol dinitrate (TEGDN) (CAS 111-22-8);
2. Trimethylolethane trinitrate (TMETN) (CAS 3032-55-1);
3. 1,2,4-butanetriol trinitrate (BTTN) (CAS 6659-60-5);

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4. Diethylene glycol dinitrate (DEGDN) (CAS 693-21-0);
5. 4,5 diazidomethyl-2-methyl-1,2,3-triazole (iso- DAMTR);
6. Nitratoethylnitramine (NENA) based plasticisers. as follows:
   a. Methyl-NENA (CAS 17096-47-8);
   b. Ethyl-NENA (CAS 85068-73-1);
   c. Butyl-NENA (CAS 82486-82-6);
7. Dinitropropyl based plasticisers. as follows:
   a. Bis (2,2-dinitropropyl) acetal (BDNPA) (CAS 5108-69-0);
   b. Bis (2.2-dinitropropyl) formal (BDNPF) (CAS 5917-61-3);

c. Stabilisers as follows:
   1. 2-Nitrodiphenylamine (CAS 119-75-5);
   2. N-methyl-p-nitroaniline (CAS 100-15-2).

4.D. SOFTWARE

4.D.1. "Software" specially designed or modified for the "use" of equipment specified in 4.B. for the "production" and handling of materials specified in 4.C.

4.E. TECHNOLOGY

4.E.1 "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or materials specified in 4.B. and 4.C.

CATEGORY II; ITEM 5

CATEGORY II; ITEM 6

ITEM 6 PRODUCTION OF STRUCTURAL COMPOSITES, PYROLYTIC DEPOSITION AND DENSIFICATION, AND STRUCTURAL MATERIALS

6.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

6.A.1. Composite structures, laminates, and manufactures thereof, specially designed for use in the systems specified in 1.A., 19.A.1. or 19.A.2. and the subsystems specified in 2.A. or 20.A.

6.A.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 1.A. **or 19.A.1.**

6.B. TEST AND PRODUCTION EQUIPMENT

6.B.1. Equipment for the "production" of structural composites, fibres, prepregs or preforms, usable in the systems specified in 1.A., 19.A.1. or 19.A.2., as follows, and specially designed components, and accessories therefor:

a. Filament winding machines or fibre placement 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;

CATEGORY II; ITEM 6

Note:

6.B.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 aluminium 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 6.B.1. are moulds, mandrels, dies, fixtures and tooling for the preform pressing, curing, casting, sintering or bonding of composite structures, laminates and manufactures thereof.

6.B.2. Nozzles specially designed for the processes referred to in 6.E.3.

6.B.3. Isostatic presses having all of the following characteristics:

a. Maximum working pressure equal to or greater than 69 MPa;

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 or greater.

6.B.4. Chemical vapour deposition furnaces designed or modified for the densification of carbon-carbon composites.

CATEGORY II; ITEM 6

6.B.5. Equipment and process controls, other than those specified in 6.B.3. or 6.B.4., designed or modified for densification and pyrolysis of structural composite rocket nozzles and re-entry vehicle nose tips.

6.C. MATERIALS

6.C.1. Resin impregnated fibre prepregs and metal coated fibre preforms, for the goods specified in 6.A.1., made either with organic matrix or metal matrix utilising 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 6.C.1. are those using resins with a glass transition temperature (Tg), after cure, exceeding 145°C as determined by ASTM D4065 or national equivalents.

Technical Notes:

1. In Item 6.C.1. 'specific tensile strength' is the ultimate tensile strength in N/m^2 divided by the 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. In Item 6.C.1. 'specific modulus' is the Young's modulus in N/m^2 divided by the specific weight in N/m^3, measured at a temperature of (296 ± 2)K ((23 ± 2)°C) and a relative humidity of (50 ± 5)%.

6.C.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 1.A. or 19.A.1.

6.C.3. Fine grain graphites with a bulk density of at least 1.72 g/cc measured at 15°C and having a grain size of 100×10^{-6} m (100 µm) or less, usable for rocket nozzles and re-entry vehicle nose tips, which can be machined to any of the following products:

CATEGORY II; ITEM 6

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; or

c. Blocks having a size of 120 mm x 120 mm x 50 mm or greater.

6.C.4. Pyrolytic or fibrous reinforced graphites usable for rocket nozzles and re-entry vehicle nose tips usable in systems specified in 1.A. or 19.A.1.

6.C.5. Ceramic composite materials (dielectric constant less than 6 at any frequency from 100 MHz to 100 GHz) for use in missile radomes usable in systems specified in 1.A. or 19.A.1.

6.C.6. Silicon-carbide materials as follows:

a. Bulk machinable silicon-carbide reinforced unfired ceramic usable for nose tips usable in systems specified in 1.A. or 19.A.1.;

b. Reinforced silicon-carbide ceramic composites usable for nose tips, re-entry vehicles, nozzle flaps, usable in systems specified in 1.A. or 19.A.1.

6.C.7. Tungsten, molybdenum, and alloys of these metals in the form of uniform spherical or atomised particles of 500 x 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 1.A. or 19.A.1.

6.C.8. Maraging steels having an ultimate tensile strength equal to or greater than 1.5 GPa, 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 1.A. or 19.A.1.

CATEGORY II; ITEM 6

Technical Note:

Maraging steels are iron alloys generally characterised by high nickel, very low carbon content and use substitutional elements or precipitates to produce strengthening and age-hardening of the alloy.

6.C.9. Titanium-stabilized duplex stainless steel (Ti-DSS) usable in the systems specified in 1.A. or 19.A.1. and having all of the following:

a. Having 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% is austenite by volume (according to ASTM E-1181-87 or national equivalents); and

b. 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.

6.D. SOFTWARE

6.D.1. "Software" specially designed or modified for the "use" of equipment specified in 6.B.1.

6.D.2. "Software" specially designed or modified for the equipment specified in 6.B.3., 6.B.4. or 6.B.5.

6.E. TECHNOLOGY

6.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment, materials or "software" specified in 6.A., 6.B., 6.C. or 6.D.

CATEGORY II; ITEM 6

6.E.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 6.A. or 6.C.

6.E.3. "Technology" for producing pyrolytically derived materials formed on a mould, mandrel or other substrate from precursor gases which decompose in the 1,300°C to 2,900°C temperature range at pressures of 130 Pa (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.

CATEGORY II; ITEM 7

CATEGORY II; ITEM 8

CATEGORY II; ITEM 9

ITEM 9 INSTRUMENTATION, NAVIGATION AND DIRECTION FINDING

9.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

9.A.1. Integrated flight instrument systems which include gyrostabilisers or automatic pilots, designed or modified for use in the systems specified in 1.A., or 19.A.1. or 19.A.2. and specially designed components therefor.

9.A.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 therefor.

9.A.3. Linear accelerometers, designed for use in inertial navigation systems or in guidance systems of all types, usable in the systems specified in 1.A., 19.A.1. or 19.A.2., having all of the following characteristics, and specially designed components therefor:

a. 'Scale factor' 'repeatability' less (better) than 1250 ppm; and
b. 'Bias' 'repeatability' less (better) than 1250 micro g.

Technical Notes:

1. 'Bias' is defined as the accelerometer output when no acceleration is applied.
2. 'Scale factor' is defined as the ratio of change in output to a change in the input.
3. The measurement of 'bias' and 'scale factor' refers to one sigma standard deviation with respect to a fixed calibration over a period of one year.
4. 'Repeatability' is defined according to IEEE Standard 528-2001 as follows: 'The closeness of agreement among repeated measurements of the same variable under the same operating conditions when changes in conditions or non-operating periods occur between measurements'.

Note:

Item 9.A.3. does not control accelerometers specially designed and developed as Measurement While Drilling (MWD) sensors for use in downhole well service operations.

CATEGORY II; ITEM 9

9.A.4. All types of gyros usable in the systems specified in 1.A., 19.A.1 or 19.A.2., 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 therefor.

Technical Notes:

1. 'Drift rate' is defined as the component of gyro output that is functionally independent of input rotation and is expressed as an angular rate. (IEEE STD 528-2001 paragraph 2.56)

2. 'Stability' is defined as a measure of the ability of a specific mechanism or performance coefficient to remain invariant when continuously exposed to a fixed operating condition. (This definition does not refer to dynamic or servo stability.) (IEEE STD 528-2001 paragraph 2.247)

9.A.5. Accelerometers or gyros of any type, designed for use in inertial navigation systems or in guidance systems of all types, specified to function at acceleration levels greater than 100 g, and specially designed components therefor.

Note :

9.A.5. does not include accelerometers that are designed to measure vibration or shock.

9.A.6. Inertial or other equipment using accelerometers specified in 9.A.3. or 9.A.5. or gyros specified in 9.A.4. or 9.A.5., and systems incorporating such equipment, and specially designed components therefor.

9.A.7. 'Integrated navigation systems', designed or modified for the systems specified in 1.A., 19.A.1. or 19.A.2. and capable of providing a navigational accuracy of 200 m CEP or less.

Technical Note.

An 'integrated navigation system' typically incorporates all of the following components:

a. An inertial measurement device (e.g. an attitude and heading reference system, inertial reference unit, or inertial navigation system);

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b. One or more external sensors used to update the position and/or velocity, either periodically or continuously throughout the flight (e.g. satellite navigation receiver, radar altimeter, and/or Doppler radar); and
c. Integration hardware and software.

N.B. For integration "software", see Item 9.D.4.

9.A.8. Three axis magnetic heading sensors having all of the following characteristics, and specially designed components therefor:
a. Internal tilt compensation in pitch (+/- 90 degrees) and having roll (+/- 180 degrees) axes.
b. Capable of providing azimuthal accuracy better (less) than 0.5 degrees rms at latitudes of +/- 80 degrees, referenced to local magnetic field; and
c. Designed or modified to be integrated with flight control and navigation systems.

Note:

Flight control and navigation systems in Item 9.A.8. include gyrostabilisers, automatic pilots and inertial navigation systems.

9.B. TEST AND PRODUCTION EQUIPMENT

9.B.1. "Production equipment", and other test, calibration and alignment equipment, other than that described in 9.B.2., designed or modified to be used with equipment specified in 9.A.

Note:

Equipment specified in 9.B.1. includes the following:

a. For laser gyro equipment, the following equipment used to characterise mirrors, having the threshold accuracy shown, or better:
1. Scatterometer (10 ppm);
2. Reflectometer (50 ppm);
3. Profilometer (5 Angstroms);

b. For other inertial equipment:
1. Inertial Measurement Unit (IMU) Module Tester;
2. IMU Platform Tester;

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3. IMU Stable Element Handling Fixture;
4. IMU Platform Balance Fixture;
5. Gyro Tuning Test Station;
6. Gyro Dynamic Balance Station;
7. Gyro Run-In/Motor Test Station;
8. Gyro Evacuation and Filling Station;
9. Centrifuge Fixture for Gyro Bearings;
10. Accelerometer Axis Align Station;
11. Accelerometer Test Station.

9.B.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 0.2 g mm per kg of rotor mass;

b. Indicator heads (sometimes known as balancing instrumentation) designed or modified for use with machines specified in 9.B.2.a.;

c. Motion simulators/rate tables (equipment capable of simulating motion) having all of the following characteristics:
1. Two axes or more;
2. Designed or modified to incorporate sliprings or integrated non-contact devices capable of transferring electrical power, signal information, or both; 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 less (better) than 5 arc second;

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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 less (better) than 5 arc second;

e. Centrifuges capable of imparting accelerations above 100 g and designed or modified to incorporate sliprings or integrated non-contact devices capable of transferring electrical power, signal information, or both.

Notes:

1. *The only balancing machines, indicator heads, motion simulators, rate tables, positioning tables and centrifuges specified in Item 9 are those specified in 9.B.2.*

2. *9.B.2.a. does not control balancing machines designed or modified for dental or other medical equipment.*

3. *9.B.2.c. and 9.B.2.d. do not control rotary tables designed or modified for machine tools or for medical equipment.*

4. *Rate tables not controlled by 9.B.2.c. and providing the characteristics of a positioning table are to be evaluated according to 9.B.2.d.*

5. *Equipment that has the characteristics specified in 9.B.2.d. which also meets the characteristics of 9.B.2.c. will be treated as equipment specified in 9.B.2.c.*

6. *Item 9.B.2.c. applies whether or not sliprings or integrated non-contact devices are fitted at the time of export.*

7. *Item 9.B.2.c. applies whether or not sliprings or integrated non-contact devices are fitted at the time of export.*

9.C. MATERIALS

None.

9.D. SOFTWARE

CATEGORY II; ITEM 9

9.D.1. "Software" specially designed or modified for the "use" of equipment specified in 9.A. or 9.B.

9.D.2. Integration "software" for the equipment specified in 9.A.1.

9.D.3. Integration "software" specially designed for the equipment specified in 9.A.6.

9.D.4. Integration "software", designed or modified for the 'integrated navigation systems' specified in 9.A.7.

Note:

A common form of integration "software" employs Kalman filtering.

9.E. TECHNOLOGY

9.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 9.A., 9.B. or 9.D.

Note:

Equipment or "software" specified in 9.A. or 9.D. may be exported as part of a manned aircraft, satellite, land vehicle, marine/submarine vessel or geophysical survey equipment or in quantities appropriate for replacement parts for such applications.

CATEGORY II: ITEM 10

ITEM 10 FLIGHT CONTROL

10.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

10.A.1. Hydraulic, mechanical, electro-optical, or electromechanical flight control systems (including fly-by-wire systems) designed or modified for the systems specified in 1.A.

10.A.2. Attitude control equipment designed or modified for the systems specified in 1.A.

10.A.3. Flight control servo valves designed or modified for the systems in 10.A.1. or 10.A.2., and designed or modified to operate in a vibration environment greater than 10 g rms between 20 Hz and 2 kHz.

Note:

Systems, equipment or valves specified in 10.A. may be exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.

10.B. TEST AND PRODUCTION EQUIPMENT

10.B.1. Test, calibration, and alignment equipment specially designed for equipment specified in 10.A.

10.C. MATERIALS

None.

10.D. SOFTWARE

10.D.1. "Software" specially designed or modified for the "use" of equipment specified in 10.A. or 10.B.

Note:

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"Software" specified in 10.D.1 may be exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.

10.E. TECHNOLOGY

10.E.1. Design "technology" for integration of air vehicle fuselage, propulsion system and lifting control surfaces, designed or modified for the systems specified in 1.A. or 19.A.2., to optimise aerodynamic performance throughout the flight regime of an unmanned aerial vehicle.

10.E.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 1.A. or 19.A.1., for optimisation of rocket system trajectory.

10.E.3. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 10.A., 10.B. or 10.D.

CATEGORY II; ITEM 11

ITEM 11 AVIONICS

11.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

11.A.1. Radar and laser radar systems, including altimeters, designed or modified for use in the systems specified in 1.A.

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.

11.A.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 1.A.

11.A.3. Receiving equipment for Global Navigation Satellite Systems (GNSS; e.g. GPS, GLONASS or Galileo), having any of the following characteristics, and specially designed components therefor:

a. Designed or modified for use in systems specified in 1.A.; or

b. Designed or modified for airborne applications and having any of the following:
   1. Capable of providing navigation information at speeds in excess of 600 m/s;
   2. Employing decryption, designed or modified for military or governmental services, to gain access to GNSS secure signal/data; or
   3. Being specially designed to employ anti-jam features (e.g. null steering antenna or electronically steerable antenna) to function in an environment of active or passive countermeasures.

Note:

11.A.3.b.2. and 11.A.3.b.3. do not control equipment designed for commercial, civil or 'Safety of Life' (e.g. data integrity, flight safety) GNSS services.

CATEGORY II; ITEM 11

11.A.4. Electronic assemblies and components, designed or modified for use in the systems specified in 1.A. or 19.A. and specially designed for military use and operation at temperatures in excess of 125°C.

Notes:

1. Equipment specified in 11.A. 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 11.A. may be exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.

11.B. TEST AND PRODUCTION EQUIPMENT

None.

11.C. MATERIALS

None.

11.D. SOFTWARE

11.D.1. "Software" specially designed or modified for the "use" of equipment specified in 11.A.1., 11.A.2. or 11.A.4.

11.D.2. "Software" specially designed for the "use" of equipment specified in 11.A.3.

11.E. TECHNOLOGY

11.E.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;

CATEGORY II; ITEM 11

b. Design "technology" for the configuration of hardened electrical circuits and subsystems;

c. Design "technology" for determination of hardening criteria for the above.

11.E.2. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 11.A. or 11.D.

CATEGORY II; ITEM 12

ITEM 12 LAUNCH SUPPORT

12.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

12.A.1. Apparatus and devices, designed or modified for the handling, control, activation and launching of the systems specified in 1.A., 19.A.1., or 19.A.2.

12.A.2. Vehicles designed or modified for the transport, handling, control, activation and launching of the systems specified in 1.A.

12.A.3. Gravity meters (gravimeters), gravity gradiometers, and specially designed components therefor, designed or modified for airborne or marine use, and having a static or operational accuracy of 7 x 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 1.A.

12.A.4. Telemetry and telecontrol equipment, including ground equipment, designed or modified for systems specified in 1.A., 19.A.1. or 19.A.2.

Notes:

1. 12.A.4. does not control equipment designed or modified for manned aircraft or satellites.

2. 12.A.4. does not control ground based equipment designed or modified for terrestrial or marine applications.

3. 12.A.4. does not control equipment designed for commercial, civil or 'Safety of Life' (e.g. data integrity, flight safety) GNSS services.

12.A.5. Precision tracking systems, usable for systems specified in 1.A., 19.A.1. or 19.A.2. as follows:

a. Tracking systems which use a code translator installed on the rocket or unmanned aerial vehicle in conjunction with either surface or airborne references or navigation satellite systems to provide real-time measurements of inflight position and velocity;

CATEGORY II; ITEM 12

b. Range instrumentation radars including associated optical/infrared trackers with all of the following capabilities:
   1. Angular resolution better than 1.5 mrad;
   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.

12.A.6. Thermal batteries designed or modified for the systems specified in 1.A., 19.A.1. or 19.A.2.

Technical Note:

Thermal batteries are single use batteries that contain a solid non-conducting inorganic salt as the electrolyte. These batteries incorporate a pyrolytic material that, when ignited, melts the electrolyte and activates the battery.

Note:

Item 12.A.6. does not control thermal batteries specially designed for rocket systems or unmanned aerial vehicles that are not capable of a "range" equal to or greater than 300 km.

12.B. TEST AND PRODUCTION EQUIPMENT

None.

12.C. MATERIALS

None.

12.D. SOFTWARE

12.D.1. "Software" specially designed or modified for the "use" of equipment specified in 12.A.1.

12.D.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 1.A., 19.A.1. or 19.A.2.

CATEGORY II; ITEM 12

12.D.3. "Software" specially designed or modified for the "use" of equipment specified in 12.A.4. or 12.A.5., usable for systems specified in 1.A., 19.A.1. or 19.A.2.

12.E. TECHNOLOGY

12.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 12.A. or 12.D.

CATEGORY II; ITEM 13

ITEM 13 COMPUTERS

13.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

13.A.1. Analogue computers, digital computers or digital differential analysers, designed or modified for use in the systems specified in 1.A., 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".

13.B. TEST AND PRODUCTION EQUIPMENT

None.

13.C. MATERIALS

None.

13.D. SOFTWARE

None.

13.E. TECHNOLOGY

13.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment specified in 13.A.

Note:

Item 13. equipment may be exported as part of a manned aircraft or satellite or in quantities appropriate for replacement parts for manned aircraft.

CATEGORY II; ITEM 14

ITEM 14 ANALOGUE TO DIGITAL CONVERTERS

14.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

14.A.1. Analogue-to-digital converters, usable in the systems specified in 1.A., 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 any 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 14.A.1.b.1.

14.B. TEST AND PRODUCTION EQUIPMENT

None.

14.C. MATERIALS

None.

14.D. SOFTWARE

None.

CATEGORY II; ITEM 14

14.E. TECHNOLOGY

14.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment specified in 14.A.

CATEGORY II; ITEM 15

ITEM 15 TEST FACILITIES AND EQUIPMENT

15.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

None.

15.B. TEST AND PRODUCTION EQUIPMENT

15.B.1. Vibration test equipment, usable for the systems specified in 1.A., 19.A.1. or 19.A.2. or the subsystems specified in 2.A. or 20.A., and components therefor, as follows:

a. Vibration test systems employing feedback or closed loop techniques and incorporating a digital controller, capable of vibrating a system at an acceleration equal to or greater than 10 g rms between 20 Hz and 2 kHz while imparting forces equal to or greater than 50 kN, measured 'bare table';

b Digital controllers, combined with specially designed vibration test "software", with a 'real-time control bandwidth' greater than 5 kHz and designed for use with vibration test systems specified in 15.B.1.a.;

Technical Note:

'Real-time control bandwidth' is defined as the maximum rate at which a controller can execute complete cycles of sampling, processing data and transmitting control signals.

c. Vibration thrusters (shaker units), with or without associated amplifiers, capable of imparting a force equal to or greater than 50 kN, measured 'bare table', and usable in vibration test systems specified in 15.B.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 equal to or greater than 50 kN, measured 'bare table', and usable in vibration test systems specified in 15.B.1.a.

Technical Note:

CATEGORY II; ITEM 15

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.

15.B.2. Wind-tunnels for speeds of Mach 0.9 or more, usable for the systems specified in 1.A. or 19.A. or the subsystems specified in 2.A. or 20.A.

15.B.3. Test benches/stands, usable for the systems specified in 1.A., 19.A.1. or 19.A.2. or the subsystems specified in 2.A. or 20.A., which have the capacity to handle solid or liquid propellant rockets, motors or engines having a thrust greater than 68 kN, or which are capable of simultaneously measuring the three axial thrust components.

15.B.4. Environmental chambers as follows, usable for the systems specified in 1.A. or 19.A. or the subsystems specified in 2.A. or 20.A.:

a. Environmental chambers capable of simulating all the following flight conditions:
   1. Having any of the following:
      a. Altitude equal to or greater than 15 km; or
      b. Temperature range from below -50°C to above 125°C; and

   2. Incorporating, or designed or modified to incorporate, a shaker unit or other vibration test equipment to produce vibration environments equal to or greater than 10 g rms, measured 'bare table', between 20 Hz and 2 kHz imparting forces equal to or greater than 5 kN;

Technical Notes:

1. Item 15.B.4.a.2. describes systems that are capable of generating a vibration environment with a single wave (e.g. a sine wave) and systems capable of generating a broad band random vibration (i.e. power spectrum).

2. In Item 15.B.4.a.2., designed or modified means the environmental chamber provides appropriate interfaces (e.g. sealing devices) to incorporate a shaker unit or other vibration test equipment as specified in this Item.

CATEGORY II; ITEM 15

b. Environmental 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 total rated acoustic power output of 4 kW or greater; and
2. Any of the following:
a. Altitude equal to or greater than 15 km; or
b. Temperature range from below -50°C to above 125°C.

15.B.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 1.A., 19.A.1. or 19.A.2. or the subsystems specified in 2.A. or 20.A.

Note:

15.B.5. does not control equipment specially designed for medical purposes.

Technical Note:

In Item 15.B. 'bare table' means a flat table, or surface, with no fixture or fittings.

15.C. MATERIALS

None.

15.D. SOFTWARE

15.D.1. "Software" specially designed or modified for the "use" of equipment specified in 15.B. usable for testing systems specified in 1.A., 19.A.1. or 19.A.2. or subsystems specified in 2.A. or 20.A.

15.E. TECHNOLOGY

15.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 15.B. or 15.D.

CATEGORY II; ITEM 15

CATEGORY II; ITEM 16

ITEM 16 MODELLING-SIMULATION AND DESIGN INTEGRATION

16.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

16.A.1. Specially designed hybrid (combined analogue/digital) computers for modelling, simulation or design integration of systems specified in 1.A. or the subsystems specified in 2.A.

Note:

This control only applies when the equipment is supplied with "software" specified in 16.D.1.

16.B. TEST AND PRODUCTION EQUIPMENT

None.

16.C. MATERIALS

None.

16.D. SOFTWARE

16.D.1. "Software" specially designed for modelling, simulation, or design integration of the systems specified in 1.A. or the subsystems specified in 2.A or 20.A.

Technical Note:

The modelling includes in particular the aerodynamic and thermodynamic analysis of the systems.

16.E. TECHNOLOGY

16.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 16.A. or 16.D.

CATEGORY II; ITEM 17

ITEM 17 STEALTH

17.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

17.A.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 1.A. or 19.A. or the subsystems specified in 2.A. or 20.A.

17.B. TEST AND PRODUCTION EQUIPMENT

17.B.1. Systems, specially designed for radar cross section measurement, usable for the systems specified in 1.A., 19.A.1. or 19.A.2. or the subsystems specified in 2.A.

17.C. MATERIALS

17.C.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 1.A. or 19.A. or the subsystems specified in 2.A.

Notes:

1. 17.C.1. includes structural materials and coatings (including paints), specially designed for reduced or tailored reflectivity or emissivity in the microwave, infrared or ultraviolet spectra.

2. 17.C.1. does not control coatings (including paints) when specially used for thermal control of satellites.

17.D. SOFTWARE

17.D.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 1.A. or 19.A. or the subsystems specified in 2.A.

Note:

CATEGORY II; ITEM 17

17.D.1. includes "software" specially designed for analysis of signature reduction.

17.E. TECHNOLOGY

17.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment, materials or "software" specified in 17.A., 17.B., 17.C. or 17.D.

Note:

17.E.1. includes databases specially designed for analysis of signature reduction.

CATEGORY II; ITEM 18

ITEM 18 NUCLEAR EFFECTS PROTECTION

18.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

18.A.1. "Radiation Hardened" "microcircuits" usable in protecting rocket systems and unmanned aerial vehicles against nuclear effects (e.g. Electromagnetic Pulse (EMP), X-rays, combined blast and thermal effects), and usable for the systems specified in 1.A.

18.A.2. 'Detectors' specially designed or modified to protect rocket systems and unmanned aerial vehicles against nuclear effects (e.g. Electromagnetic Pulse (EMP), X-rays, combined blast and thermal effects), and usable for the systems specified in 1.A.

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.

18.A.3. Radomes designed to withstand a combined thermal shock greater than 4.184×10^6 J/m^2 accompanied by a peak over pressure of greater than 50 kPa, usable in protecting rocket systems and unmanned aerial vehicles against nuclear effects (e.g. Electromagnetic Pulse (EMP), X-rays, combined blast and thermal effects), and usable for the systems specified in 1.A.

18.B. TEST AND PRODUCTION EQUIPMENT

None.

18.C. MATERIALS

None.

18.D. SOFTWARE

None.

CATEGORY II; ITEM 18

18.E. TECHNOLOGY

18.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment specified in 18.A.

CATEGORY II; ITEM 19

ITEM 19 OTHER COMPLETE DELIVERY SYSTEMS

19.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

19.A.1. Complete rocket systems (including ballistic missile systems, space launch vehicles, and sounding rockets), not specified in 1.A.1., capable of a "range" equal to or greater than 300 km.

19.A.2. Complete unmanned aerial vehicle systems (including cruise missile systems, target drones and reconnaissance drones), not specified in 1.A.2., capable of a "range" equal to or greater than 300 km.

19.A.3. Complete unmanned aerial vehicle systems, not specified in 1.A.2. or 19.A.2., having all of the following:

a. Having any of the following:
   1. An autonomous flight control and navigation capability; or
   2. Capability of controlled flight out of the direct vision range involving a human operator; and

b. Having any of the following:
   1. Incorporating an aerosol dispensing system/mechanism with a capacity greater than 20 litres; or
   2. Designed or modified to incorporate an aerosol dispensing system/mechanism with a capacity greater than 20 litres.

Technical Notes:

1. An aerosol consists of particulate or liquids other than fuel components, by-products or additives, as part of the "payload" to be dispersed in the atmosphere. Examples of aerosols include pesticides for crop dusting and dry chemicals for cloud seeding.

2. An aerosol dispensing system/mechanism contains all those devices (mechanical, electrical, hydraulic, etc.), which are necessary for storage and dispersion of an aerosol into the atmosphere. This includes the possibility of aerosol injection into the combustion exhaust vapour and into the propeller slip stream.

CATEGORY II; ITEM 19

Note:

Item 19.A.3. does not control model aircraft, specially designed for recreational or competition purposes.

19.B. TEST AND PRODUCTION EQUIPMENT

None.

19.C. MATERIALS

None.

19.D. SOFTWARE

19.D.1. "Software" which coordinates the function of more than one subsystem, specially designed or modified for "use" in the systems specified in 19.A.1. or 19.A.2.

19.E. TECHNOLOGY

19.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment specified in 19.A. 1. or 19.A.2.

CATEGORY II; ITEM 20

ITEM 20 OTHER COMPLETE SUBSYSTEMS

20.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

20.A.1. Complete subsystems as follows:

a. Individual rocket stages, not specified in 2.A.1., usable in systems specified in 19.A.;

b. Solid propellant rocket motors or liquid propellant rocket engines, not specified in 2.A.1., usable in systems specified in 19.A., having a total impulse capacity equal to or greater than 8.41×10^5 Ns, but less than 1.1×10^6 Ns.

20.B. TEST AND PRODUCTION EQUIPMENT

20.B.1. "Production facilities" specially designed for the subsystems specified in 20.A.

20.B.2. "Production equipment" specially designed for the subsystems specified in 20.A.

20.C. MATERIALS

None.

20.D. SOFTWARE

20.D.1. "Software" specially designed or modified for the systems specified in 20.B.1.

20.D.2. "Software", not specified in 2.D.2., specially designed or modified for the "use" of rocket motors or engines specified in 20.A.1.b.

20.E. TECHNOLOGY

20.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 20.A., 20.B. or 20.D.

UNITS, CONSTANTS, ACRONYMS AND ABBREVIATIONS

UNITS, CONSTANTS, ACRONYMS AND ABBREVIATIONS USED IN THIS ANNEX

ABEC	Annular Bearing Engineers Committee
ABMA	American Bearing Manufactures Association
ANSI	American National Standards Institute
Angstrom	1×10^{-10} metre
ASTM	American Society for Testing and Materials
bar	unit of pressure
°C	degree Celsius
cc	cubic centimetre
CAS	Chemical Abstracts Service
CEP	Circle of Equal Probability
dB	decibel
g	gram; also, acceleration due to gravity
GHz	gigahertz
GNSS	Global Navigation Satellite System e.g. 'Galileo' 'GLONASS' - Global'naya Navigatsionnaya Sputnikovaya Sistema 'GPS' – Global Positioning System
h	hour
Hz	hertz
HTPB	Hydroxy–Terminated Polybutadiene
ICAO	International Civil Aviation Organisation
IEEE	Institute of Electrical and Electronic Engineers
IR	Infrared
ISO	International Organization for Standardization
J	joule
JIS	Japanese Industrial Standard
K	Kelvin
kg	kilogram
kHz	kilohertz
km	kilometre
kN	kilonewton
kPa	kilopascal
kW	kilowatt
m	metre
MeV	million electron volt or mega electron volt
MHz	megahertz
milligal	10^{-3} m/s^2 (also called mGal, mgal or milligalileo)
mm	millimetre
mm Hg	mm of mercury
MPa	megapascal
mrad	milliradian
ms	millisecond
µm	micrometre

UNITS, CONSTANTS, ACRONYMS AND ABBREVIATIONS

N	newton
Pa	pascal
ppm	parts per million
rads (Si)	radiation absorbed dose
RF	radio frequency
rms	root mean square
rpm	revolutions per minute
RV	Re-entry Vehicles
s	second
Tg	glass transition temperature
Tyler	Tyler mesh size, or Tyler standard sieve series
UAV	Unmanned Aerial Vehicle
UV	Ultra violet

TABLE OF CONVERSIONS

TABLE OF CONVERSIONS USED IN THIS ANNEX		
Unit (from)	Unit (to)	Conversion
bar	pascal (Pa)	1 bar = 100 kPa
g (gravity)	m/s^2	1 g = 9.806 65 m/s^2
mrad (millirad)	degrees (angle)	1 mrad ≈ 0.0573°
rads	ergs/gram of Si	1 rad (Si) = 100 ergs/gram of silicon (= 0.01 gray [Gy])
Tyler 250 mesh	mm	for a Tyler 250 mesh, mesh opening 0.063 mm

ADDENDUM – STATEMENT OF UNDERSTANDING

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.

PART III

(paragraph 4)

LIST OF ENTITIES AND PERSONS SUBJECT TO THE MEASURES IMPOSED BY PARAGRAPH 8 OF RESOLUTION 1718 (2006)

(A) Entities

The Committee designated the following entities to be subject to the measures imposed in paragraph 8(d) of Security Council Resolution 1718 (2006):

1. **KOREA MINING DEVELOPMENT TRADING CORPORATION** (a.k.a. CHANGGWANG SINYONG CORPORATION; a.k.a. EXTERNAL TECHNOLOGY GENERAL CORPORATION; a.k.a. DPRKN MINING DEVELOPMENT TRADING CORPORATION; a.k.a. "KOMID"). Central District, Pyongyang, DPRK. Primary arms dealer and main exporter of goods and equipment related to ballistic missiles and conventional weapons.
2. **KOREA RYONBONG GENERAL CORPORATION** (a.k.a. KOREA YONBONG GENERAL CORPORATION; f.k.a. LYONGAKSAN GENERAL TRADING CORPORATION). Pothonggang District, Pyongyang, DPRK; Rakwon-dong, Pothonggang District, Pyongyang, DPRK. Defense conglomerate specializing in acquisition for DPRK defense industries and support to that country's military-related sales.
3. **TANCHON COMMERCIAL BANK** (f.k.a. CHANGGWANG CREDIT BANK; f.k.a., KOREA CHANGGWANG CREDIT BANK). Saemul 1-Dong Pyongchon District, Pyongyang, DPRK. Main DPRK financial entity for sales of conventional arms, ballistic missiles, and goods related to the assembly and manufacture of such weapons.
4. **NAMCHONGANG TRADING CORPORATION**

   Description: Namchongang is a DPRK trading company subordinate to the General Bureau of Atomic Energy (GBAE). Namchongang has been involved in the procurement of Japanese origin vacuum pumps that were identified at a DPRK nuclear facility, as well as nuclear-related procurement associated with a German individual. It has further been involved in the purchase of aluminum tubes and other equipment specifically suitable for a

uranium enrichment program from the late 1990s. Its representative is a former diplomat who served as DPRK's representative for the IAEA inspection of the Yongbyon nuclear facilities in 2007. Namchongang's proliferation activities are of grave concern given the DPRK's past proliferation activities.

Location: Pyongyang, DPRK.

A.K.A.: NCG; NAMCHONGANG TRADING; NAM CHON GANG CORPORATION; NOMCHONGANG TRADING CO.; NAM CHONG GAN TRADING CORPORATION

5. **HONG KONG ELECTRONICS**

Description: owned or controlled by, or acts or purports to act for or on behalf of Tanchon Commercial Bank and KOMID. Hong Kong Electronics has transferred millions of dollars of proliferation-related funds on behalf of Tanchon Commercial Bank and KOMID (both designated by the Committee in April 2009) since 2007. Hong Kong Electronics has facilitated the movement of money from Iran to the DPRK on behalf of KOMID.

Location: Sanaee St., Kish Island, Iran.

A.K.A.: HONG KONG ELECTRONICS KISH CO.

6. **KOREA HYOKSIN TRADING CORPORATION**

Description: a DPRK company based in Pyongyang that is subordinate to Korea Ryonbong General Corporation (designated by the Committee in April 2009) and is involved in the development of WMD.

Location: Rakwon-dong, Pothonggang District, Pyongyang, DPRK.

A.K.A.: KOREA HYOKSIN EXPORT AND IMPORT CORPORATION

7. **GENERAL BUREAU OF ATOMIC ENERGY (GBAE)**

Description: The GBAE is responsible for the DPRK's nuclear program, which includes the Yongbyon Nuclear Research Center and its 5 Mwe (25 MWt) plutonium production research reactor, as well as its fuel fabrication and reprocessing facilities. The GBAE has held nuclear-related meetings and discussions with the International Atomic Energy Agency. GBAE is the primary DPRK government agency that oversees nuclear programs, including the operation of the Yongbyon Nuclear Research Center.

Location: Haeudong, Pyongchen District, Pyongyang, DPRK.

A.K.A.: General Department of Atomic Energy (GDAE)