

No. 429  
10 April 2002

NOTICE IN TERMS OF SECTION 13 OF THE NON-PROLIFERATION OF WEAPONS OF MASS DESTRUCTION ACT, 1993

DECLARATION OF CERTAIN MISSILE TECHNOLOGY AND RELATED ITEMS AS CONTROLLED GOODS AND CONTROL MEASURES APPLICABLE TO SUCH GOODS

1. I, Alec Erwin, Minister of Trade and Industry, on the recommendation of the South African Council for the Non-Proliferation of Weapons of Mass Destruction, under section 13 of the Non-Proliferation of Weapons of Mass Destruction Act, 1993 (Act No. 87 of 1993), hereby -

- (a) declare all items listed in the Missile Technology Control Regime (MTCR) Equipment and Technology Annex, dated 14 October 1999, as quoted in Schedule A to this notice, to be controlled goods;
- (b) determine that the import, export, re-export and transit of such controlled goods shall take place only under a permit issued by the said Council, established under section 4 of the said Act;
- (c) determine that the local transfer or sale of such controlled goods by a person contemplated in section 13(3) of the said Act may take place only if the receiver of the goods has been registered in terms of this said section and the said Council was informed by means of a declaration of the transaction by the supplier; and
- (d) repeal Government Notice No. R.1789 of 14 October 1994.

2. Application forms for permits and registrations in terms of section 13(3) of the aforementioned Act are obtainable from:

The Secretariat  
South African Council for the Non-Proliferation of Weapons of Mass Destruction  
Private Bag X84  
PRETORIA  
0001

signed  
C ERWIN,  
Minister of Trade and Industry

SCHEDULE A

CONTROLLED GOODS CONCERNING MISSILE TECHNOLOGY AND RELATED ITEMS

QUOTE

## 1. INTRODUCTION

- (a) This Annex consists of two categories of items, which term includes equipment, materials, "software" or "technology". Category 1 items, all of which are in Annex items 1 and 2, are those items of greatest sensitivity. If a Category 1 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 air 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".

- (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".

## 2. DEFINITIONS

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

"Basic scientific research"

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

"Development"

Is related to all phases prior to "production" such as:

- design
- design research
- design analysis
- design concepts
- assembly and testing of prototypes
- pilot production schemes
- design data
- process of transforming design data into a product
- configuration design
- integration design
- layouts

"in the public domain"

This means "software" or "technology" which has been made available without restrictions upon its further dissemination. (Copyright restrictions do not remove "software" or "technology" from being "in the public domain".)

"Microcircuit"

A device in which a number of passive and/or active elements are considered as indivisibly associated on or within a continuous structure to perform the function of a circuit.

"Microprogrammes"

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

"Production"

Means all production phases such as:

- production engineering
- manufacture
- integration
- assembly (mounting)
- inspection
- testing
- quality assurance

"Production equipment"

Means tooling, templates, jigs, mandrels, moulds, dies, fixtures, alignment mechanisms, test equipment, other machinery and components 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.

"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  $5 \times 10^5$  rads (Si).

## "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
- training
- working knowledge
- consulting service

## "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

### 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" or "capable of" describes equipment, parts, components or "software" which are suitable for a particular purpose. There is no need for the equipment, parts, components or "software" to have been configured, modified or specified for the particular purpose. For example, any military specification memory circuit would be "capable of operation in a guidance system.
- (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 1

##### 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 air vehicle systems (including cruise missile systems, target drones and reconnaissance drones) capable of delivering at least a 500 kg payload to a range of at least 300 km.

### 1.13. TEST AND PRODUCTION EQUIPMENT

1.13.1. "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 1.13.

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., 1.13., or 1.D.

## 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 Note 1 below for those designed for non-weapon payloads:

1. Heat shields, and components thereof, fabricated of ceramic or ablative materials;

2. Heat sinks and components thereof fabricated of light-weight, high heat capacity materials;

3. Electronic equipment specially designed for re-entry vehicles;

c. Solid propellant rocket motors or liquid propellant rocket engines, usable in the systems specified in 1.A., having a total impulse capacity of  $1.1 \times 10^6$  Ns ( $2.5 \times 10^5$  Ib.s) or greater;

Note:

Liquid propellant apogee engines specified in 2.A.1.c., designed or modified for satellite applications, may be treated as Category II if the subsystem is exported subject to end use statements and quantity limits appropriate for the excepted end use stated above, when having all of the following parameters: a. nozzle throat diameter of 20 mm or less, and

b. combustion chamber pressure of 15 bar or less.

d. 'Guidance sets', usable in the systems specified in 1.A., capable of achieving system accuracy of  $3.33\sigma$  or less of the range (e.g. a 'CEP' of 10 km or less at a range of 300 km), except as provided in Note 1 below for those designed for missiles with a range under 300 km or manned aircraft;

Technical Notes:

1. A 'guidance set' integrates the process of measuring and computing a vehicle's position and velocity (i.e. navigation) with that of computing and sending commands to the vehicle's flight control systems to correct the trajectory.

2. 'CEP' (circle of equal probability) is a measure of accuracy, defined as the radius of the circle centred at the target, at a specific range, in which 50% of the payloads impact.

e. Thrust vector control sub-systems, usable in the systems specified in 1.A., except as provided in Note 1 below for those designed for rocket systems that do not exceed the range/payload capability of systems specified in 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, fusing, and firing mechanisms, usable in the systems specified in 1.A., except as provided in Note 1 below for those designed for systems other than those specified in 1.A.

Note:

The exceptions in 2.A. 1.b., 2.A. 1.c., 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.

## 2.13. TEST AND PRODUCTION EQUIPMENT

2.13.1. "Production facilities" specially designed for the subsystems specified in 2.A. 2.13.2. "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 2.13.1.

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 11 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.;
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 PROPULSION COMPONENTS AND EQUIPMENT

#### 3.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

3.A.1. Lightweight turbojet and turbofan engines (including turbocompound engines), usable in the systems specified in 1.A., that are small and fuel efficient, as follows:

a. Engines having both of the following characteristics

1. Maximum thrust value greater than 1,000 N (achieved un-installed) excluding civil certified engines with a maximum thrust value greater than 8,890 N (achieved un-installed); and

2. Specific fuel consumption of 0.13 kg N-1 h-1 or less (at sea level static and standard conditions);

b. Engines designed or modified for systems specified in 1.A., 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.

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

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.

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 of more 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 of 24 litres per minute or greater, at an absolute pressure of 7,000 kPa (9,000 psi) or greater, that have an actuator response time of less than 900 ms;
- b. Pumps, for liquid propellants, with shaft speeds equal to or greater than 8, 000 RPM or with discharge pressures equal to or greater than 7, 000 kPa (9,000 psi).

2. Systems and components specified in 3.A.5. maybe 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.

### 3.13. TEST AND PRODUCTION EQUIPMENT

3.13.1. "Production facilities" specially designed for equipment or materials specified in 3.A. or 3.C.

3.13.2. "Production equipment' specially designed for equipment or materials specified in 3.A. or 3.C.

3.13.3. 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 coordinated simultaneously for contouring control.

Technical Note:

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

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 9.A.

### 3.C. MATERIALS

3.C.1. 'Interior lining' usable for rocket motor cases in the systems specified in 1.A.

Technical Note:

In 3. C. 9. '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.

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. or 3.A.6.

Notes:

(a) "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.

(b) "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.

3.13.3. "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., 3. B., 3. C. or 3. D.

## ITEM 4 PROPELLANTS AND CHEMICALS

### 4.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

None.

### 4.B. TEST AND PRODUCTION EQUIPMENT

None.

### 4.C. MATERIALS

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

4.C.2. Fuel substances as follows:

- a. Hydrazine with a concentration of more than 70 percent and its derivatives including monomethylhydrazine (MMH);
- b. Unsymmetrical dimethylhydrazine (UDMH);
- c. Spherical aluminium powder with particles of uniform diameter of less than  $200 \times 10^{-6}$  m (200  $\mu$ m) and an aluminium content of 97 percent by weight or more, if at least 10 percent of the total weight is made up of particles of less than 63  $\mu$ m, according to ISO 2591:1988 or national equivalents such as JIS Z8820;

Technical Note:

A particle size of 63 Nm (!SO R-565) corresponds to 250 mesh ( Tyler) or 230 mesh (ASTM standard E-11).

- d. Zirconium, beryllium, magnesium and alloys of these in particle size less than  $60 \times 10^{-6}$  m (60 um), whether spherical, atomised, spheroidal, flaked or ground, consisting of 97 percent by weight or more of any of the above mentioned metals;

Technical Note:

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

- e. Boron and boron alloys in particle size less than  $60 \times 10^{-6}$  m (60 um), whether spherical, atomised, spheroidal, flaked or ground with a purity of 85 percent by weight or more;
- f. High energy density materials such as boron slurry, having an energy density of  $40 \times 10^6$  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. Liquid oxidiser substances as follows:

1. Dinitrogen trioxide;
2. Nitrogen dioxide/dinitrogen tetroxide;
3. Dinitrogen pentoxide;
4. Inhibited Red Fuming Nitric Acid (IRFNA);

5. Compounds composed of fluorine and one or more of other halogens, oxygen or nitrogen;

b. Solid oxidiser substances as follows:

1. Ammonium perchlorate;
2. Ammonium dinitramide (ADN);
3. Nitro-amines (cyclotetramethylene - tetranitramine (HMX); cyclotrimethylene - trinitramine (RDX)).

4.C.5. Polymeric substances as follows:

- a. Carboxy - terminated polybutadiene (CTPB);
- b. Hydroxy - terminated polybutadiene (HTPB);
- c. Glycidyl azide polymer (GAP);
- d. Polybutadiene - Acrylic Acid (PBAA);
- e. Polybutadiene - Acrylic Acid- Acrylonitrile (PBAN).

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

a. Bonding agents as follows:

- 1. tris (1-(2-methyl)aziridinyl) phosphine oxide (MAPO);
- 2. trimesoyl-1 (2-ethyl) aziridine (HX-868, BITA);
- 3. Tapanol (HX878), reaction product of tetraethylenepentamine, acrylonitrile and glycidol;
- 4. Tapan (HX-879), reaction, product of tetraethylenepentamine and acrylonitrile;
- 5. Polyfunctional aziridine amides with isophthalic, trimesic, isocyanuric, or trimethyladipic backbone also having a 2-methyl or 2-ethyl aziridine group (HX-752, HX-874 and HX-877);

b. Curing agent and catalysts as follows: Triphenyl bismuth (TPB);

c. Burning rate modifiers as follows:

- 1. Catocene;
- 2. N-butyl-ferrocene;
- 3. Butacene;
- 4. Other adducted polymer ferrocene derivatives;
- 5. Carboranes, decarboranes, pentaboranes and derivatives thereof;

d. Nitrate esters and nitrated plasticisers as follows:

- 1. Triethylene glycol dinitrate (TEGDN);
- 2. Trimethylolethane trinitrate (TMETN);
- 3. 1,2,4-butanetriol trinitrate (BTTN);
- 4. Diethylene glycol dinitrate (DEGDN);

e. Stabilisers as follows:

1. 2-Nitrodiphenylamine;
2. N-methyl-p-nitroaniline.

#### 4.D. SOFTWARE

None.

#### 4.E. TECHNOLOGY

4.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of materials specified in 4.C. (See also Item 5.E.).

### ITEM 5 PROPELLANT PRODUCTION

#### 5.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

None.

#### 5.13. TEST AND PRODUCTION EQUIPMENT

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

5.13.2. "Production equipment", other than that described in 5.13.3., 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 Item 4.

5.13.3. 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 temperature control capability of the mixing chamber and having all of the following:
  1. two or more mixing/kneading shafts; and
  2. capability to open the mixing chamber;

- c. Fluid energy mills usable for grinding or milling substances specified in Item 4;
- d. Metal powder "production equipment" usable for the "production", in a controlled environment, of spherical or atomised materials specified in 4.C.2.c. or 4.C.2.d:

Note:

5.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 argonwater 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 Item 4, and fluid energy mills controlled in Item 5, are those specified in 5.B.3.
2. Forms of metal powder "production equipment" not specified in 5.B.3.d. are to be evaluated in accordance with 5.13.2.

## 5.C. MATERIALS

None.

## 5.D. SOFTWARE

5.D.1. "Software" specially designed or modified for the "use" of equipment specified in 5.13. for the "production" and handling of materials specified in Item 4.

## 5.E. TECHNOLOGY

5.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment specified in 5. B.

# ITEM 6 PRODUCTION OF STRUCTURAL COMPOSITES

## 6.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

None.

## 6.13. TEST AND PRODUCTION EQUIPMENT

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

- a. Filament winding machines of which the motions for positioning, wrapping and winding fibres can be coordinated and programmed in three or more axes, designed to fabricate composite structures or laminates from fibrous or filamentary materials, and co-ordinating and programming controls;
- b. Tape-laying machines of which the motions for positioning and laying tape and sheets can be co-ordinated and programmed in two or more axes, designed for the manufacture of composite airframes and missile structures;
- c. Multi-directional, multi-dimensional weaving machines or interlacing machines, including adapters and modification kits for weaving, interlacing or braiding fibres to manufacture composite structures;

Note:

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 6.13.1. are moulds, mandrels, dies, fixtures and tooling for the preform pressing, curing, casting, sintering or bonding of composite structures,

laminates and manufactures thereof.

#### 6.C. MATERIALS

None.

#### 6.D. SOFTWARE

6.D.1. "Software" specially designed or modified for the "use" of equipment specified in 6.13.

#### 6.E. TECHNOLOGY

6.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 6.13. or 6.13.

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 Item 8.

### ITEM 7 PYROLYTIC DEPOSITION AND DENSIFICATION

#### 7.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

None.

#### 7.13. TEST AND PRODUCTION EQUIPMENT

7.13.1. Nozzles specially designed for the processes referred to in 7.E.1.

7.13.2. Isostatic presses having all of the following characteristics:

- a. Maximum working pressure of 69 MPa (10,000 psi) or greater;
- b. Designed to achieve and maintain a controlled thermal environment of 600 C or greater; and
- c. Possessing a chamber cavity with an inside diameter of 254 mm (10 inches) or greater.

7.13.3. Chemical vapour deposition furnaces designed or modified for the densification of carbon-carbon composites.

7.13.4. Equipment and process controls, other than those specified in 7.13.2. or 7.13.3., designed or modified for densification and pyrolysis of structural composite rocket nozzles and reentry vehicle nose tips.

## 7.C. MATERIALS

None.

## 7.13. SOFTWARE

7.13.1. "Software" specially designed or modified for the equipment specified in 7.13.2., 7. B.3. or 7. B.4.

## 7.E. TECHNOLOGY

7.E.1. "Technology" for producing pyrolytically derived materials formed on a mould, mandrel or other substrate from precursor gases which decompose in the 1300 C to 2900 C temperature range at pressures of 130 Pa (1 mm Hg) to 20 kPa (150 mm Hg) including "technology" for the composition of precursor gases, flow-rates, and process control schedules and parameters.

7.E.2. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 7.13. or 7.13.

## ITEM 8 STRUCTURAL MATERIALS

### 8.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

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

8.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.

### 8.B. TEST AND PRODUCTION EQUIPMENT

None.

### 8.C. MATERIALS

8.C.1. Resin impregnated fibre prepregs and metal coated fibre preforms, for the goods specified in 8.A.1., made either with organic matrix or metal matrix utilising fibrous or filamentary reinforcements having a specific tensile strength greater than  $7.62 \times 10^6$  and a specific modulus greater than  $3.18 \times 10^6$  m.

Note:

The only resin impregnated fibre prepregs specified in 8. C.1. are

those using resins with a glass transition temperature ( $T_g$ ), after cure, exceeding 145(degrees) as determined by ASTM D4065 or national equivalents.

8.C.2. Resaturated pyrolysed (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.

8.C.3. Fine grain recrystallised bulk graphites (with a bulk density of at least 1.72 g/cm<sup>3</sup> measured at 15 degree Celsius) and having a particle size of  $100 \times 10^{-6}$  m (100 um) or less, usable for rocket nozzles and re-entry vehicle nose tips usable in systems specified in 1.A.

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

8.C.5. Ceramic composite materials (dielectric constant less than 6 at frequencies from 100 Hz to 10 GHz) for use in missile radomes usable in systems specified in 1.A.

8.C.6. Bulk machinable silicon-carbide reinforced unfired ceramic usable for nose tips usable in systems specified in 1.A.

8.C.7. Tungsten, molybdenum, and alloys of these metals in the form of uniform spherical or atomised particles of  $500 \times 10^{-6}$  m (500 um) 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.

8.C.8. Maraging steels having an ultimate tensile strength of  $1.5 \times 10^9$  Pa or greater, measured at 20C, 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.

Technical Note:

Maraging steels are generally characterised by high nickel, very low carbon content and use substitutional elements or precipitates to produce age hardening.

8.C.9. Titanium-stabilized duplex stainless steel (Ti-DSS) usable in the systems specified in 1.A. 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 percent is austenite by volume (according to ASTM E-1181-87 or national equivalents); and

b. Having any of the following forms:

1. ingots or bars having a size of 100 mm or more in each dimension;
2. sheets having a width of 600 mm or more and a thickness of 3 mm or less; or
3. tubes having an outer diameter of 600 mm or more and a wall thickness of 3 mm or less.

#### 8.D. SOFTWARE

None.

#### 8.E. TECHNOLOGY

8.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or materials specified in 8.A. or 8.C.

### 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., 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. Accelerometers with a threshold of 0.05 g or less, or a linearity error within 0.25% of full scale output, or both, which are designed for use in inertial navigation systems or in guidance systems of all types, and specially designed components therefor.

Note:

Accelerometers which are specially designed and developed as MWD (Measurement While Drilling) sensors for use in downhole well service operations are not controlled in 9.A.3.

9.A.4. All types of gyros usable in the systems specified in 1.A., 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 time rate of output deviation from the desired output. It consists of random and systematic components and is expressed as an equivalent angular displacement per unit time with respect to inertial space.

2. 'Stability' is defined as the standard deviation (1 sigma) of the variation of a particular parameter from its calibrated value measured under stable temperature conditions. This can be expressed as a function of time.

9.A.5. Continuous output accelerometers or gyros of any type, specified to function at acceleration levels greater than 100 g, and specially designed components therefor.

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.B. TEST AND PRODUCTION EQUIPMENT

9.B.1. "Production equipment", and other test, calibration and alignment equipment, other than that described in 9.13.2., 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;
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. slip rings capable of transmitting electrical power and/or signal information; and

3. having any of the following characteristics:

a. for any single axis having all of the following:

1. capable of rates of 400 degrees/s or more, or 30 degrees/s or less; and

2. a rate resolution equal to or less than 6 degrees/s and an accuracy equal to or less than 0.6 degrees/s;

b. having a worst-case rate stability equal to or better (less) than plus or minus 0.05% averaged over 10 degrees or more; or

c. a positioning accuracy equal to or better than 5 arc second;

d. Positioning tables (equipment capable of precise rotary positioning in any axes) having the following characteristics:

1. two axes or more; and
  2. a positioning accuracy equal to or better than 5 arc second;
- e. Centrifuges capable of imparting accelerations above 100 g and having slip rings capable of transmitting electrical power and signal information.

Notes:

1. The only balancing machines, indicator heads, motion simulators, rate tables, positioning tables and centrifuges specified in 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.

#### 9.C. MATERIALS

None.

#### 9.D. SOFTWARE

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.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., 9.13. or 9.13.

Note:

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

## 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.

Note:

Systems or equipment 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 10.13.

Note:

"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., to optimise aerodynamic performance throughout the flight regime of an unmanned air 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., 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., 10.13. or 10.D.

## 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. Global Positioning System (GPS) or similar satellite receivers, designed or modified for use in the systems specified in 1.A., having any of the following characteristics:

- a. Capable of providing navigation information under the following operational conditions:
  1. At speeds in excess of 515 m/s (1,000 nautical miles/hour); and
  2. At altitudes in excess of 18 km (60,000 feet); or
- b. Designed or modified for use with unmanned air vehicles specified in 1.A.2.

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

#### 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;
- 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 11.13.

### 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.

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  $7 \times 10^{-6}$  m/s<sup>2</sup> (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 having all of the following:

- a. usable for unmanned air vehicles or rocket systems; and
- b. usable for systems specified in 1.A.

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

- a. Tracking systems which use a code translator installed on the rocket or unmanned air vehicle in conjunction with either surface or airborne references or navigation satellite systems to provide real-time measurements of inflight position and velocity;
- b. Range instrumentation radars including associated optically infrared trackers with all of the following capabilities:
  1. angular resolution better than 3 mrad (0.5 mils);
  2. range of 30 km or greater with a range resolution better than 10 m RMS; and
  3. velocity resolution better than 3 m/s.

## 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.

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.

#### 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 12.13.

#### 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 degrees Celsius to above +55 degrees Celsius; or
- b. Designed as ruggedised or "radiation hardened".

##### 13.B. TEST AND PRODUCTION EQUIPMENT

None.

##### 13.C. MATERIALS

None.

##### 13.13. 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.

#### 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 "radiationhardened" 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 degreeed Celsius to above +125 degreeed Celsius ; 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 degreeed Celsius to above +55 degreeed Celsius; 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.

#### 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.

### 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. or the subsystems specified in 2.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 10 g RMS or more over the entire range 20 Hz to 2 kHz and imparting forces of 50 kN (11,250 lbs), measured bare table, or greater;

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

c. Vibration thrusters (shaker units), with or without associated amplifiers, capable of imparting a force of 50 kN (11,250 lbs), measured bare table, or greater, and usable in vibration test systems specified in 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 of 50 kN, measured bare table, or greater, and usable in vibration test systems specified in 15.B.1.a.

Technical Note:

Vibration test systems incorporating a digital controller are those systems, the functions of which are, partly or entirely, automatically controlled by stored and digitally coded electrical signals.

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

15.B.3. Test benches/stands, usable for the systems specified in 1.A. or the subsystems specified in 2.A., which have the capacity to handle solid or liquid propellant rockets, motors or engines of more than 90 kN (20,000 lbs) of thrust, or which are capable of simultaneously measuring the three axial thrust components.

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

a. Environmental chambers capable of simulating all of the following flight conditions:

1. Vibration environments of 10 g RMS or greater between 20 Hz and 2 kHz imparting forces of 5 kN or greater; and

2. any of the following:

a. Altitude of 15,000 m or greater; or

b. Temperature range of at least -50 (degrees)C to 125 013;

b. Anechoic chambers capable of simulating all of the following flight conditions: 1. Acoustic environments at an overall sound pressure level of 140 dB or greater (referenced to  $2 \times 10^{-5}$  N/m<sup>2</sup>) or with a rated power output of 4 kW or greater; and 2. any of the following: a. Altitude of 15,000 m or greater; or

b. Temperature range of at least -50 degeed Celsius to 125 degeed Celsius.

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. or the subsystems specified in 2.A.

Note:

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

#### 15.C. MATERIALS

None.

#### 15.B. SOFTWARE

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

### 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.

#### 16.13. TEST AND PRODUCTION EQUIPMENT

None.

## 16.C. MATERIALS

None.

## 16.13. SOFTWARE

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

## 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 the subsystems specified in 2.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. 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 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 the subsystems specified in 2.A.

Note:

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

## 17.E. TECHNOLOGY

"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.

## ITEM 18 NUCLEAR EFFECTS PROTECTION

### EQUIPMENT, ASSEMBLIES AND COMPONENTS

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

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

### 18.A.3.

Radomes designed to withstand a combined thermal shock greater than  $4.184 \times 10^6$  J/m<sup>2</sup> accompanied by a peak over pressure of greater than 50 kPa, usable in protecting rocket systems and unmanned air vehicles against nuclear effects (e.g. Electromagnetic Pulse (EMP), X-rays,

combined blast and thermal effects), and usable for the systems specified in 1.A.

18.B. TEST AND PRODUCTION EQUIPMENT None.

18.C. MATERIALS None.

18.D. SOFTWARE None.

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.

## 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 maximum range equal to or greater than 300 km.

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

19.B. TEST AND PRODUCTION EQUIPMENT

None.

19.C. MATERIALS

None.

19.13. SOFTWARE

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

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.

## 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 of  $8.41 \times 10^5$  Ns ( $1.91 \times 10^5$  lb. s) or greater, but less than  $1.1 \times 10^6$  Ns ( $2.5 \times 10^5$  lb.s).

### 20.13. TEST AND PRODUCTION EQUIPMENT

20.13.1. "Production facilities" specially designed for the subsystems specified in 20.A. 20.13.2. "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 20.13.1.

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.

## 1. INTRODUCTION

(a) This Annex consists of two categories of items, which term includes equipment, materials, "software" or "technology". Category 1 items, all of which are in Annex items 1 and 2, are those items of greatest sensitivity. If a Category 1 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 air 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".

(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".

## 2. DEFINITIONS

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

"Basic scientific research"

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

"Development"

Is related to all phases prior to "production" such as: -design

-design research

-design analysis

-design concepts

-assembly and testing of prototypes

-pilot production schemes

-design data

-process of transforming design data into a product -configuration design

-integration design -layouts

"in the public domain"

This means "software" or "technology" which has been made available without restrictions upon its further dissemination. (Copyright restrictions do not remove "software" or "technology" from being "in the public domain".)

"Microcircuit"

A device in which a number of passive and/or active elements are considered as indivisibly associated on or within a continuous structure to perform the function of a circuit.

"Microprogrammes"

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

"Production"

Means all production phases such as:

-production engineering

-manufacture

-integration

-assembly (mounting)

-inspection

-testing

-quality assurance

"Production equipment"

Means tooling, templates, jigs, mandrels, moulds, dies, fixtures, alignment mechanisms, test equipment, other machinery and components 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.

"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  $5 \times 10^5$  rads (Si).

"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

-training

-working knowledge

-consulting service

"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

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

(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 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 air vehicle systems (including cruise missile systems, target drones and reconnaissance drones) capable of delivering at least a 500 kg payload to a range of at least 300 km.

#### 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.

### 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 Note 1 below for those designed for non-weapon payloads:

1. Heat shields, and components thereof, fabricated of ceramic or ablative materials;

2. Heat sinks and components thereof fabricated of light-weight, high heat capacity materials;

3. Electronic equipment specially designed for re-entry vehicles;

c. Solid propellant rocket motors or liquid propellant rocket engines, usable in the systems specified in 1.A., having a total impulse capacity of  $1.1 \times 10^6$  Ns ( $2.5 \times 10^5$  lb.s) or greater;

Note:

Liquid propellant apogee engines specified in 2.A.1.c., designed or modified for satellite applications, may be treated as Category II, if the subsystem is exported subject to end use statements and quantity limits appropriate for the excepted end use stated above, when having all of the following parameters:

a. nozzle throat diameter of 20 mm or less, and

b. combustion chamber pressure of 15 bar or less.

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

Technical Notes:

1. A 'guidance set' integrates the process of measuring and computing a vehicle's position and velocity (i.e. navigation) with that of computing and sending commands to the vehicle's flight control systems to correct the trajectory.

2. 'CEP' (circle of equal probability) is a measure of accuracy, defined as the radius of the circle centred at the target, at a specific range, in which 50% of the payloads impact.

e. Thrust vector control sub-systems, usable in the systems specified

in 1.A., except as provided in Note 1 below for those designed for rocket systems that do not exceed the range/payload capability of systems specified in 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, fusing, and firing mechanisms, usable in the systems specified in 1.A., except as provided in Note 1 below for those designed for systems other than those specified in 1.A.

Note:

The exceptions in 2.A. 1.b., 2.A. 1.c., 2.A. 1.d., 2.A. 1.e. and 2.A. 1.f above may be treated as Category 11 if the subsystem is exported subject to end use statements and quantity limits appropriate for the excepted end use stated above.

## 2.13. TEST AND PRODUCTION EQUIPMENT

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

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

## 2.C. MATERIALS

None.

## 2.13. SOFTWARE

2.13.1. "Software" specially designed or modified for the "use" of "production facilities" specified in 2.13.1.

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

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

Note:

2.13.3. 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.

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

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

2.13.6. "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.

2.13.6. may be treated as Category 11 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.;

2. Under 2.D.3. if designed for missiles with a range of under 300 km or manned aircraft, 1000.

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.;

6. Under 2.13.6. 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 PROPULSION COMPONENTS AND EQUIPMENT

#### 3.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

3.A.1. Lightweight turbojet and turbofan engines (including turbocompound engines), usable in the systems specified in 1.A., that are

small and fuel efficient, as follows:

a. Engines having both of the following characteristics

1. Maximum thrust value greater than 1,000 N (achieved un-installed) excluding civil certified engines with a maximum thrust value greater than 8,890 N (achieved un-installed); and

2. Specific fuel consumption of 0.13 kg N-1 h-1 or less (at sea level static and standard conditions);

b. Engines designed or modified for systems specified in 1.A., 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.

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

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.

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 of more 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 of 24 litres per minute or greater, at an absolute pressure of 7,000 kPa (1,000 psi) or greater, that have an actuator response time of less than 100 ms;

b. Pumps, for liquid propellants, with shaft speeds equal to or greater than 8, 000 RPM or with discharge pressures equal to or greater than 7, 000 kPa (1,000 psi).

2. Systems and components specified in 3.A.5. maybe 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.

### 3.B. TEST AND PRODUCTION EQUIPMENT

3.B.1. "Production facilities" specially designed for equipment or materials specified in 3.A. or 3.C.

3.B.2. "Production equipment" specially designed for equipment or materials specified in 3.A. 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.

### 3.C. MATERIALS

3.C.1. 'Interior lining' usable for rocket motor cases in the systems specified in 1.A.

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.

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.B. SOFTWARE

3.B.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.B.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. or 3.A.6.

Notes:

(a) "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.

(b) "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.B.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., 3.B., 3.C. or 3.B.

ITEM 4 PROPELLANTS AND CHEMICALS

4.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS None.

4.B. TEST AND PRODUCTION EQUIPMENT None.

4.C. MATERIALS

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

4.C.2. Fuel substances as follows:

a. Hydrazine with a concentration of more than 70 percent and its derivatives including monomethylhydrazine (MMH);

b. Unsymmetrical dimethylhydrazine (UDMH);

c. Spherical aluminium powder with particles of uniform diameter of less than  $200 \times 10^{-6}$  m (200  $\mu$ m) and an aluminium content of 97 percent by weight or more, if at least 10 percent of the total weight is made up of particles of less than 63  $\mu$ m, according to ISO 2591:1988 or national equivalents such as JIS Z8820;

Technical Note:

A particle size of 63  $\mu$ m (ISO P-565) corresponds to 250 mesh (Tyler) or 230 mesh (ASTM standard E-11).

d. Zirconium, beryllium, magnesium and alloys of these in particle size less than  $60 \times 10^{-6}$  m (60  $\mu$ m), whether spherical, atomised, spheroidal, flaked or ground, consisting of 97 percent by weight or more of any of the above mentioned metals;

Technical Note:

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

e. Boron and boron alloys in particle size less than  $60 \times 10^{-6}$  m (60  $\mu$ m), whether spherical, atomised, spheroidal, flaked or ground with a purity of 85 percent by weight or more;

f. High energy density materials such as boron slurry, having an energy density of  $40 \times 10^6$  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. Liquid oxidiser substances as follows:

1. Dinitrogen trioxide;

2. Nitrogen dioxide/dinitrogen tetroxide;

3. Dinitrogen pentoxide;

4. Inhibited Red Fuming Nitric Acid (IRFNA);

5. Compounds composed of fluorine and one or more of other halogens,

oxygen or nitrogen;

b. Solid oxidiser substances as follows:

1. Ammonium perchlorate;
2. Ammonium dinitramide (ADN);
3. Nitro-amines (cyclotetramethylene -tetranitramine (HMX); cyclotrimethylene -trinitramine (RDX).

4.C.5. Polymeric substances as follows:

- a. Carboxy -terminated polybutadiene (CTPB);
- b. Hydroxy -terminated polybutadiene (HTPB);
- c. Glycidyl azide polymer (GAP);
- d. Polybutadiene -Acrylic Acid (PBAA);
- e. Polybutadiene -Acrylic Acid-Acrylonitrile (PBAN).

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

a. Bonding agents as follows:

1. tris (1-(2-methyl)aziridiny) phosphine oxide (MAPO);
2. trimesoyl-1 (2-ethyl) aziridine (HX-868, BITA);
3. Tepanol (HX878), reaction product of tetraethylenepentamine, acrylonitrile and glycidol;
4. Teapan (HX-879), reaction product of tetraethylenepentamine and acrylonitrile;
5. Polyfunctional aziridine amides with isophthalic, trimesic, isocyanuric, or trimethyladipic backbone also having a 2-methyl or 2-ethyl aziridine group (HX-752, HX-874 and HX-877);

b. Curing agent and catalysts as follows: Triphenyl bismuth (TPB);

c. Burning rate modifiers as follows: 1. Catocene;

2. N-butyl-ferrocene; 3. Butacene;

4. Other adducted polymer ferrocene derivatives;

5. Carboranes, decarboranes, pentaboranes and derivatives thereof;

d. Nitrate esters and nitrated plasticisers as follows:

1. Triethylene glycol dinitrate (TEGDN);
2. Trimethylolethane trinitrate (TMETN);
3. 1,2,4-butanetriol trinitrate (BTTN);
4. Diethylene glycol dinitrate (DEGDN);

e. Stabilisers as follows:

1. 2-Nitrodiphenylamine; 2. N-methyl-p-nitroaniline.

#### 4.D. SOFTWARE

None.

#### 4.E. TECHNOLOGY

4.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of materials specified in 4.C. (See also Item 5.E.).

### ITEM 5 PROPELLANT PRODUCTION

#### 5.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

None.

#### 5.B. TEST AND PRODUCTION EQUIPMENT

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

5.B.2. "Production equipment", other than that described in 5.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 Item 4.

5.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 temperature control capability of the mixing chamber and having all of the following:

1. two or more mixing/kneading shafts; and
2. capability to open the mixing chamber;

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

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

Note:

5. 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 argonwater 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 Item 4, and fluid energy mills controlled in Item 5, are those specified in 5.B.3.

2. Forms of metal powder "production equipment" not specified in 5.B.3.d. are to be evaluated in accordance with 5.B.2.

## 5.C. MATERIALS

None.

## 5.D. SOFTWARE

5.D.1. "Software" specially designed or modified for the "use" of equipment specified in 5.B. for the "production" and handling of materials specified in Item 4.

## 5.E. TECHNOLOGY

5.E.1. "Technology", in accordance with the General Technology Note,

for the "development", "production" or "use" of equipment specified in 5.B.

## ITEM 6 PRODUCTION OF STRUCTURAL COMPOSITES

### 6.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

None.

### 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., as follows, and specially designed components, and accessories therefor:

a. Filament winding machines of which the motions for positioning, wrapping and winding fibres can be co-ordinated and programmed in three or more axes, designed to fabricate composite structures or laminates from fibrous or filamentary materials, and co-ordinating and programming controls;

b. Tape-laying machines of which the motions for positioning and laying tape and sheets can\_ be co-ordinated and programmed in two or more axes, designed for the manufacture of composite airframes and missile structures;

c. Multi-directional, multi-dimensional weaving machines or interlacing machines, including adapters and modification kits for weaving, interlacing or braiding fibres to manufacture composite structures;

Note:

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.C. MATERIALS

None.

#### 6.D. SOFTWARE

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

#### 6.E. TECHNOLOGY

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

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 Item 8.

### ITEM 7 PYROLYTIC DEPOSITION AND DENSIFICATION

#### 7.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

None.

#### 7.B. TEST AND PRODUCTION EQUIPMENT

7.B.1. Nozzles specially designed for the processes referred to in 7.E.1.

7.B.2. Isostatic presses having all of the following characteristics:

- a. Maximum working pressure of 69 MPa (10,000 psi) or greater;
- b. Designed to achieve and maintain a controlled thermal environment of 600 degree Celsius or greater; and
- c. Possessing a chamber cavity with an inside diameter of 254 mm (10 inches) or greater.

7.B.3. Chemical vapour deposition furnaces designed or modified for the densification of carbon-carbon composites.

7.B.4. Equipment and process controls, other than those specified in 7.B.2. or 7.B.3., designed or modified for densification and pyrolysis of structural composite rocket nozzles and reentry vehicle nose tips.

#### 7.C. MATERIALS

None.

#### 7.D. SOFTWARE

7.D.1. "Software" specially designed or modified for the equipment specified in 7.B.2., 7. B.3. or 7. B.4.

#### 7.E. TECHNOLOGY

7.E.1. "Technology" for producing pyrolytically derived materials formed on a mould, mandrel or other substrate from precursor gases which decompose in the 1300 degreeed Celsius to 2900 degreeed Celsius 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.

7.E.2. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or "software" specified in 7.B. or 7. D.

### ITEM 8 STRUCTURAL MATERIALS

#### 8.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

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

8.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.

#### 8.B. TEST AND PRODUCTION EQUIPMENT

None.

#### 8.C. MATERIALS

8.C.1. Resin impregnated fibre prepregs and metal coated fibre preforms, for the goods specified in 8.A.1., made either with organic matrix or metal matrix utilising fibrous or filamentary reinforcements having a specific tensile strength greater than  $7.62 \times 10^6$  m and a specific modulus greater than  $3.18 \times 10^6$  m.

Note:

The only resin impregnated fibre prepregs specified in 8.C.1. are those using resins with a glass transition temperature ( $T_g$ ), after cure, exceeding 145(degrees) as determined by AS TM D4065 or national equivalents.

8.C.2. Resaturated pyrolysed (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.

8.C.3. Fine grain recrystallised bulk graphites (with a bulk density of at least 1.72 g/cm<sup>3</sup> measured at 15 degrees Celsius) and having a particle size of 100 x 10<sup>-6</sup> m (100 um) or less, usable for rocket nozzles and re-entry vehicle nose tips usable in systems specified in 1.A.

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

8.C.5. Ceramic composite materials (dielectric constant less than 6 at frequencies from 100 Hz to 10 GHz) for use in missile radomes usable in systems specified in 1.A.

8.C.6. Bulk machinable silicon-carbide reinforced unfired ceramic usable for nose tips usable in systems specified in 1.A.

8.C.7. Tungsten, molybdenum, and alloys of these metals in the form of uniform spherical or atomised particles of 500 x 10<sup>-6</sup> m (500 um) 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.

8.C.8. Maraging steels having an ultimate tensile strength of 1.5 x 10<sup>9</sup> Pa or greater, measured at 20degrees Celsius, 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.

Technical Note:

Maraging steels are generally characterised by high nickel, very low carbon content and use substitutional elements or precipitates to produce agehardening.

8.C.9. Titanium-stabilized duplex stainless steel (Ti-DSS) usable in the systems specified in 1.A. 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 percent is austenite by volume (according to ASTM E-1181-87 or national equivalents); and

b. Having any of the following forms:

1. ingots or bars having a size of 100 mm or more in each dimension;
2. sheets having a width of 600 mm or more and a thickness of 3 mm or less; or
3. tubes having an outer diameter of 600 mm or more and a wall thickness of 3 mm or less.

#### 8.D. SOFTWARE

None.

#### 8.E. TECHNOLOGY

8.E.1. "Technology", in accordance with the General Technology Note, for the "development", "production" or "use" of equipment or materials specified in 8.A. or 8. C.

### 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., 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. Accelerometers with a threshold of 0.05 g or less, or a linearity error within 0.25% of full scale output, or both, which are designed for use in inertial navigation systems or in guidance systems of all types, and specially designed components therefor.

Note:

Accelerometers which are specially designed and developed as MWD (Measurement While Drilling) sensors for use in downhole well service operations are not controlled in 9.A.3.

9.A.4. All types of gyros usable in the systems specified in 1.A., 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 time rate of output deviation from the desired output. It consists of random and systematic components and is expressed as an equivalent angular displacement per unit time with respect to inertial space.

2. 'Stability' is defined as the standard deviation (1 sigma) of the variation of a particular parameter from its calibrated value measured under stable temperature conditions. This can be expressed as a function of time.

9.A.5. Continuous output accelerometers or gyros of any type, specified to function at acceleration levels greater than 100 g, and specially designed components therefor.

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.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 9.8.1. 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, 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. slip rings capable of transmitting electrical power and/or signal information; and

3. having any of the following characteristics:

a. for any single axis having all of the following:

1. capable of rates of 400 degrees/s or more, or 30 degrees/s or less; and

2. a rate resolution equal to or less than 6 degrees/s and an accuracy equal to or less than 0.6 degrees/s;

b. having a worst-case rate stability equal to or better (less) than plus or minus 0.05% averaged over 10 degrees or more; or

c. a positioning accuracy equal to or better than 5 arc second;

d. Positioning tables (equipment capable of precise rotary positioning in any axes) having the following characteristics:

1. two axes or more; and

2. a positioning accuracy equal to or better than 5 arc second;

e. Centrifuges capable of imparting accelerations above 100 g and having slip rings capable of transmitting electrical power and signal information.

Notes:

1. The only balancing machines, indicator heads, motion simulators, rate tables, positioning tables and centrifuges specified in 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.

#### 9.C. MATERIALS

None.

#### 9.D. SOFTWARE

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.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 or marine vessel or in quantities appropriate for replacement parts for such applications.

## 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.

Note:

Systems or equipment 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.

### 10.13. TEST AND PRODUCTION EQUIPMENT

10.13.1. 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 10.13.

Note:

"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., to optimise aerodynamic performance throughout the flight regime of an unmanned air 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., 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., 10.13. or 10.D.

## ITEM 11 AVIONICS

### EQUIPMENT, ASSEMBLIES AND COMPONENTS

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. Global Positioning System (GPS) or similar satellite receivers, designed or modified for use in the systems specified in 1.A., having any of the following characteristics:

a. Capable of providing navigation information under the following operational conditions:

1. At speeds in excess of 515 m/s (1,000 nautical miles/hour); and
2. At altitudes in excess of 18 km (60,000 feet); or

b. Designed or modified for use with unmanned air vehicles specified in 1.A.2.

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

#### 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.

#### 11.13. 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;

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.

### 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.

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  $7 \times 10^{-6}$  m/s<sup>2</sup> (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 having all of the following:

- a. usable for unmanned air vehicles or rocket systems; and
- b. usable for systems specified in 1.A.

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

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

b. Range instrumentation radars including associated optical/infrared trackers with all of the following capabilities:

1. angular resolution better than 3 mrad (0.5 mils);
- 2 range of 30 km or greater with a range resolution better than 10 m RMS; and
3. velocity resolution better than 3 m/s.

## 12.B. TEST AND PRODUCTION EQUIPMENT

None.

12.C. MATERIALS None.

## 12.B. SOFTWARE

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

12.B.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.

12.B.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.

## 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.

## 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 degree Celsius to above +55 degree Celsius; or

b. Designed as ruggedised or "radiation hardened".

### 13.B. TEST AND PRODUCTION EQUIPMENT

None.

### 13.C. MATERIALS

None.

### 13.B. 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.

## 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 "radiationhardened" 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 degreeed Celsius to above +125 degreeed Celsius ; 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 degreeed Celsius 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.

#### 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.

### 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. or the subsystems specified in 2.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 10 g RMS or more over the entire range 20 Hz to 2 kHz and imparting forces of 50 kN (11,250 lbs), measured bare table, or greater;

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

c. Vibration thrusters (shaker units), with or without associated amplifiers, capable of imparting a force of 50 kN (11,250 lbs), measured bare table, or greater, and usable in vibration test systems specified in 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 of 50 kN, measured bare table, or greater, and usable in vibration test systems specified in 15.B.1.a.

#### Technical Note:

Vibration test systems incorporating a digital controller are those systems, the functions of which are, partly or entirely, automatically controlled by stored and digitally coded electrical signals.

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

15.B.3. Test benches/stands, usable for the systems specified in 1.A. or the subsystems specified in 2.A., which have the capacity to handle solid or liquid propellant rockets, motors or engines of more than 90 kN (20,000 lbs) of thrust, or which are capable of simultaneously measuring the three axial thrust components.

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

a. Environmental chambers capable of simulating all of the following flight conditions:

1. Vibration environments of 10 g RMS or greater between 20 Hz and 2 kHz imparting forces of 5 kN or greater; and

2. any of the following:

a. Altitude of 15,000 m or greater; or

b. Temperature range of at least -50 degrees Celsius to 125 degrees Celsius;

b. Anechoic chambers capable of simulating all of the following

flight conditions: 1. Acoustic environments at an overall sound pressure level of 140 dB or greater (referenced to  $2 \times 10^{-5}$  N/m<sup>2</sup>) or with a rated power output of 4 kW or greater; and 2. any of the following: a. Altitude of 15,000 m or greater; or

b. Temperature range of at least -50 degrees Celsius to 125 degrees Celsius.

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. or the subsystems specified in 2.A.

Note:

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

#### 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. or subsystems specified in 2.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.

### 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.B. SOFTWARE

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

## 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 the subsystems specified in 2.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. or the subsystems specified in 2.A.

### 17.B. MATERIALS

17.B.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 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.B. SOFTWARE

17.B.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 the subsystems specified in 2.A.

Note:

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

## TECHNOLOGY

"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.

## ITEM 18 NUCLEAR EFFECTS PROTECTION

### 18.A. EQUIPMENT, ASSEMBLIES AND COMPONENTS

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

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

### 18.A.3.

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

### 18.B. TEST AND PRODUCTION EQUIPMENT

None.

#### 18.C. MATERIALS

None.

#### 18.D. SOFTWARE

None.

#### 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.

### 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 maximum range equal to or greater than 300 km.

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

#### 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.

#### 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.

### 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 of  $8.41 \times 10^5$  Ns ( $1.91 \times 10^5$  lb. s) or greater, but less than  $1.1 \times 10^6$  Ns ( $2.5 \times 10^5$  lb.s).

#### 20.13. TEST AND PRODUCTION EQUIPMENT

20.13.1. "Production facilities" specially designed for the subsystems specified in 20.A. 20.13.2. "Production equipment" specially designed for the subsystems specified in 20.A. 20.C. MATERIALS  
None.

#### 20.13. SOFTWARE

20.13.1. "Software" specially designed or modified for the systems specified in 20.13.1.

20.13.2. "Software", not specified in 2.1).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.