SCHEDULE 1 Article 2

PROHIBITED GOODS—MISCELLANEOUS

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PART I

1. In Group 1 of this Part—

(a) "bovine offal" means the brain, spinal cord, spleen, thymus, tonsils and intestines of a bovine animal over six months of age which has died or has been slaughtered, as the case may be, in the United Kingdom;

(b) "intestines" means that part of the digestive tract of a bovine animal from the junction of the abomasum and the duodenum to (and including) the rectum; and

(c) any description of goods specified in relation to a Combined Nomenclature heading or sub-heading, other than one covering a whole heading, shall be taken to comprise all goods which would be classified under an entry in the same terms constituting a sub-heading in the relevant heading in the Combined Nomenclature of the European Economic Community(**1**).

GROUP 1

GOODS SPECIFIED BY REFERENCE TO HEADINGS AND SUB-HEADINGS OF THE COMBINED NOMENCLATURE ("CN")

2. The following goods are prohibited to be exported to any destination unless the place of export is in Great Britain, or the export of the goods is from Northern Ireland to the Republicof Ireland:

CN Heading and Sub-heading No.	Description of Goods
1002	Live bovine animals
0103	Live swine
010410	Live sheep.

3. The following goods are prohibited to be exported to any destination except a destination in another Member State:

CN Heading and Sub-heading No.	Description of Goods
ex 0206	Bovine offal
ex 0210 Protein derived from bovine offal	
ex 0504	Bovine offal

(**1**) Annex 1 to Commission Regulation (EEC) No. 2505/92 O.J. L267, 14.9.92, p1.

CN Heading and Sub-heading No.	Description of Goods
ex 0511 Bovine offal and protein derived from such offal	
ex 2301	Protein derived from bovine offal
ex 2309	Feeding stuff containing bovine offal or protein derived from such offal.

GROUP 2

ANTIQUES

4. Any goods manufactured or produced more than 50 years before the date of exportation except:

(1) postage stamps and other articles of philatelic interest;

(2) birth, marriage or death certificates or other documents relating to the personal affairs of the exporter or the spouse of the exporter;

(3) letters or other writings written by or to the exporter or the spouse of the exporter; and

(4) any goods exported by, and being the personal property of, the manufacturer or producer thereof, or the spouse, widow or widower of that person.

PART II

Goods capable of being used in relation to chemical, biological or nuclear weapons and related missiles

1. Goods of a description specified in paragraph (2) below are prohibited to be exported to any destination—

(a) if the exporter knows that they are intended or likely to be used in—

(i) the development, production, handling, operation, delivery, detection, identification or storage of any chemical or biological weapon;

(ii) the disposal of waste arising out of the development or production of any chemical or biological weapon;

(iii) the development, production, handling, operation, delivery, detection, identification or storage of any vaccine, toxoid, protein or immunoglobulin for protection against, or the treatment of, the harmful effects of any chemical or biological weapon;

(iv) the development, production, handling, operation, delivery, or storage of any nuclear weapon; or

(v) the development, production, handling, operation, delivery or storage of missiles capable of delivering any nuclear, chemical or biological weapon;

(b) where the exporter knows or has grounds for suspecting that they might be used for any purpose referred to in sub-paragraph (a) above, unless he has made all reasonable enquiries as to their proposed use and satisfied himself that the goods will not be so used.

(a) (a) Any chemical, toxin, microorganism or other biological agent;

(b) Any vaccine, toxoid, protein or immunoglobulin capable of being used for protection against, or treatment of, any harmful effect of any chemical, toxin, microorganism or other biological agent;

(c) Any equipment (including clothing), software or materials capable of being used in the development, production, handling, operation, delivery, detection, identification or storage of any of the substances specified in sub-paragraph (a) or (b) above;

(d) Any equipment (including clothing), software or materials capable of being used in the disposal of waste arising out of the development or production of substances specified in sub-paragraph (a) or (b) above;

(e) Any equipment (including clothing), software or materials capable of being used in the development, production, handling, operation, delivery or storage of nuclear weapons or missiles capable of delivering nuclear, chemical or biological weapons;

(f) Technology the information in which includes information relating to any goods in sub-paragraphs (a) to (e) above.

PART III

Note: The goods in this Part are for convenience specified by reference to the classification system used by the Department of Trade and Industry for export control purposes (which in the case of Groups 2 and 3 has been developed by technical experts from Member States for such purposes). For convenience only, defined terms are highlighted in bold type and technical notes of an advisory nature are included.

GROUP 1

MILITARY, SECURITY AND PARA-MILITARY GOODS AND ARMS, AMMUNITION AND RELATED MATERIAL

Definitions

In this Group:

"adapted for use in war" means any modification or selection (such as altering purity, shelf life, virulence, dissemination characteristics, or resistance to ultra violet (UV) radiation designed to increase the effectiveness in producing casualties in men or animals, degrading equipment or damaging crops or the environment);

"anti-idiotypic antibodies" means antibodies which bind to the specific antigen binding sites of other antibodies;

"biocatalyst" means **enzymes** and other biological compounds which bind to and accelerate the degradation of chemical warfare (CW) agents;

"biopolymer" means the following biological macromolecules:

(a) **enzymes;**

(b) antibodies, **monoclonal, polyclonal or anti-idiotypic;**

(c) specially designed or specially processed **receptors;**

the "critical temperature" (sometimes referred to as the transition temperature) of a specific **superconductive** material means the temperature at which the specific material loses all resistance to the flow of direct electrical current;

"end-effectors" include grippers, **active tooling units** and any other tooling that is attached to the baseplate on the end of a **robot** manipulator arm; for this purpose, **active tooling unit** means a device for applying motive power, process energy or sensing to the workpiece;

"enzymes" means **biocatalysts** for specific chemical or biochemical reactions;

"expression vectors" means carriers including plasmid or virus types, which are used to introduce genetic material into host cells;

"improvised explosive devices" means devices placed or fabricated in an improvised manner incorporating destructive, lethal, noxious, pyrotechnic or incendiary chemicals, designed to destroy, disfigure or harass; they may incorporate military stores, but are normally devised from non-military components;

a "laser" is an assembly of components which produce both spatially and temporally coherent light which is amplified by stimulated emission of radiation;

"military propellants" means solid, liquid or gaseous substances or mixtures of substances used for propelling projectiles and missiles, or to generate gases for powering auxiliary devices for military equipment which, when ignited, burn or deflagrate to produce quantities of gas capable of performing work, but in their application these quantities are required not to undergo a deflagration to detonation transition;

"military pyrotechnics" means mixtures of solid or liquid fuels and oxidisers which, when ignited, undergo an energetic chemical reaction at a controlled rate intended to produce specific time delays, or quantities of heat, noise, smoke, visible light or infrared radiation; pyrophorics are a subclass of pyrotechnics, which contain no oxidisers but ignite spontaneously on contact with air;

"monoclonal antibodies" means proteins which bind to one antigenic site and are produced by a single clone of cells;

"nuclear reactor" means the items within or attached directly to the reactor vessel, the equipment which controls the level of power in the core, and the components which normally contain, come into direct contact with or control the primary coolant of the reactor core;

"polyclonal antibodies" means a mixture of proteins which bind to the specific antigen and are produced by more than one clone of cells;

"receptors" means biological macromolecular structures capable of binding ligands, the binding of which affects physiological functions;

"riot control agents"means substances, including tear gases, which produce temporary, irritating or disabling physical effects which disappear within minutes of removal from exposure;

"robot" means a manipulation mechanism, which may be of the continuous path or of the point-to-point variety, may use sensors, and which:

(a) is multifunctional;

(b) is capable of positioning or orienting material, parts, tools or special devices through variable movements in three dimensional space;

(c) incorporates three or more closed or open loop servo-devices which may include stepping motors; and

(d) has **user-accessible programmability** by means of the teach/playback method or by means of an electronic computer which may be a programmable logic controller, i.e.,without mechanical intervention;

except:

(1) manipulation mechanisms which are only manually/teleoperator controllable;

(2) fixed sequence manipulation mechanisms, which are automated moving devices, operating according to programmes where the motions are limited by fixed stops, such as pins or cams and the sequence of motions and the selection of paths or angles are not variable or changeable by mechanical, electronic or electrical means;

(3) mechanically controlled variable sequence manipulation mechanisms, which are automated moving devices, operating according to programmes where the motions are limited by fixed, but adjustable stops, such as pins or cams and the sequence of motions and the selection of paths or angles are variable within the fixed programme pattern; variations or modifications of the programme pattern (e.g., changes of pins or exchanges of cams) in one or more motion axes are accomplished only through mechanical operations;

(4) non-servo-controlled variable sequence manipulation mechanisms, which are automated moving devices, operating according to mechanically fixed programmed motions; the programme is variable but the sequence proceeds only by the binary signal from mechanically fixed electrical binary devices or adjustable stops;

(5) stacker cranes defined as Cartesian co-ordinate manipulator systems manufactured as an integral part of a vertical array of storage bins and designed to access the contents of those bins for storage or retrieval;

"superconductive" refers to materials (i.e., metals, alloys or compounds) which can lose all electrical resistance (i.e., which can attain infinite electrical conductivity and carry very large electrical currents without Joule heating); the superconductive state of a material is individually characterised by a **critical temperature,** a critical magnetic field, which is a function of temperature, and a critical current density which is a function of both magnetic field and temperature;

"user-accessible programmability" means the facility allowing a user to insert, modify or replace **programmes** by means other than:

(a) a physical change in wiring or interconnections; or

(b) the setting of function controls including entry of parameters.

ML1

Small arms, machine guns and accessories, as follows, and specially designed components therefor:

(a) Rifles, carbines, revolvers, pistols, machine pistols and machine guns;

(b) Smooth-bore weapons specially designed for military use;

(c) Weapons using caseless ammunition;

(d) Silencers, special gun-mountings, clips and flash suppressors for the goods specified in heads a., b. and c. above;

except:

(a) Air weapons (other than those declared by the Firearms (Dangerous Air Weapons) Rules 1969(**2**) to be specially dangerous);

(b) Firearms specially designed for dummy ammunition and which are incapable of firing any ammunition specified in this Group;

(c) Firearms which have been de-activated by a registered UK Proof House as being incapable of firing any ammunition specified in this Group;

(d) Bayonets.

PL5002

Telescopic sights for firearms.

(**2**) S.I.1969/47.

PL5018

Smooth-bore weapons other than those specially designed for military use;

except:

Air weapons (other than those declared by the Firearms (Dangerous Air Weapons) Rules 1969 to be specially dangerous).

PL5021

Ammunition, including projectiles, and specially designed components therefor, for the **goods** specified in entry PL5018.

ML2

Large calibre armament or weapons, projectors and accessories, as follows, and specially designed components therefor:

(a) Guns, howitzers, cannon, mortars, tank destroyers, projectile launchers, military flame throwers, recoilless rifles and signature reduction devices therefor;

(b) Military smoke, gas and pyrotechnic projectors or generators. In this entry specially designed components include injectors, metering devices and storage tanks for use with liquid propelling charges.

ML3

Ammunition, including projectiles, and specially designed components therefor, for the **goods** specified in entries ML1, ML2 or ML26.

ML4

Bombs, torpedoes, rockets, missiles and accessories, as follows, and specially designed components therefor:

(a) Bombs, torpedoes, grenades, smoke canisters, rockets, mines, missiles, depth charges, demolition—charges, —devices and —kits, **military pyrotechnics,** cartridges and simulators;

except:

Rockets or smoke canisters designed for the purposes of entertainment, distress or Safety of Life at Sea (SOLAS);

(b) Equipment specially designed for the handling, control, activation, powering with one time operational output, launching, laying, sweeping, discharging, decoying, jamming, detonation or detection of **goods** specified in head a. above.

PL5006

Apparatus or devices specially designed for military use, for the handling, control, discharging, decoying, jamming, detonation, disruption or detection of **improvised explosive devices** or other explosive devices not specified in head a. of entry ML4;

except:

Inspection devices not employing electronic management.

ML5

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

(a) Weapon sights, bombing computers, gun laying equipment and on-board weapon control systems;

(b) Target acquisition, designation, range-finding, surveillance or tracking systems; detection, recognition or identification equipment; and sensor integration equipment.

ML6

Vehicles and related equipment specially designed or modified for military use, as follows, and specially designed components therefor:

(a) Tanks and self-propelled guns;

(b) Armed, armoured vehicles and vehicles fitted with mounting for arms;

(c) Armoured railway trains;

(d) Half-tracks;

(e) Recovery vehicles;

(f) Gun-carriers, tractors and trailers specially designed for towing or transporting ammunition or weapon systems and related load handling equipment;

(g) Amphibious and deep water fording vehicles;

(h) Mobile repair shops specially designed to service military equipment;

(i) All other vehicles specially designed or modified for military use, including tank transporters, tracked amphibious cargo carriers, high speed tractors, heavy artillery transporters, bridge laying vehicles and specialised bulk refuellers;

(j) Pneumatic tyre casings of a kind specially constructed to be bullet proof or to run when deflated;

(k) Engines and power transfer systems for the propulsion of the vehicles specified in heads a. to i. above, and specially designed components therefor;

(l) Tyre inflation pressure control systems, operated from inside a moving vehicle, specially designed or modified for military use;

(m) Suspensions specially designed or modified for military use.

In this entry ‘modified for military use’ means a structural, electrical or mechanical change which entails replacing a component with at least one specially designed military component, or adding at least one such component.

ML7

Toxicological agents, **riot control agents** and related equipment, components, materials and **technology,** as follows:

(a) Biological agents and radioactive materials **adapted for use in war** to produce casualties in humans or animals, degrade equipment or damage crops or the environment, and chemical warfare (CW) agents;

except:

1. Cyanogen chloride;

2. Hydrocyanic acid;

3. Chlorine;

4. Carbonyl chloride (phosgene);

5. Diphosgene (trichloromethyl-chloroformate);

6. Ethyl bromoacetate;

7. Xylyl bromide;

8. Benzyl bromide;

9. Benzyl iodide;

10. Bromoacetone;

11. Cyanogen bromide;

12. Bromomethylethylketone;

13. Chloroacetone;

14. Ethyl iodoacetate;

15. Iodoacetone;

16. Chloropicrin;

(b) CW binary precursors, as follows:

1. DF:Methyl phosphonyldifluoride;

2. QL:o—Ethyl—2—diisopropylaminoethyl methylphosphonite;

(c) **Riot control agents,** including tear gases;

(d) Equipment specially designed or modified for the dissemination of the materials or agents specified in head a. above and specially designed components therefor;

(e) Equipment specially designed or modified for defence against materials or agents specified in head a. above and specially designed components therefor;

(f) Equipment specially designed or modified for the detection or identification of materials or agents specified in head a. above and specially designed components therefor;

except:

Personal radiation monitoring dosimeters;

(g) **Biopolymers** specially designed or processed for detection and identification of chemical warfare (CW) agents specified in head a. above and the cultures of specific cells used to produce them;

(h) **Biocatalysts** for decontamination or degradation of CW agents, and biological systems therefor, as follows:

1. Biocatalysts, specially designed for decontamination or degradation of CW agents described in head a. above resulting from directed laboratory selection or genetic manipulation of biological systems;

2. Biological systems, as follows: expression vectors, viruses or cultures of cells containing the genetic information specific to the production of **biocatalysts** specified in subhead h.1. above;

(i) **Technology,** as follows:

1. Technology for the **development, production** or **use** of toxicological agents, related equipment or components, agents, or materials specified in heads a. to f. above;

2. Technology for the **development, production** or **use** of **biopolymers,** or cultures of specific cells, specified in head g. above;

3. Technology exclusively for the incorporation of **biocatalysts** specified in subhead h.1. above into military carrier substances or military material.

ML8

Military explosives and propellants, and related substances, as follows:

(a) Substances, as follows, and mixtures therefor:

1. Spherical aluminium powder with a particle size of 60 micrometres or less, manufactured from material with an aluminium content of 99% or more;

2. Metal fuels in particle sizes of less than 60 micrometres whether spherical, atomized, spheroidal, flaked or ground, manufactured from material consisting of 99% or more of any of the following:

(a) Zirconium, magnesium and alloys of these;

(b) Beryllium;

(c) Iron powder with average particle size of 3 micrometres or less produced by reduction of iron oxide with hydrogen;

(d) Boron or boron carbide fuels of 85% purity or higher and average particle size of 60 micrometres or less;

3. Perchlorates, chlorates and chromates composited with powdered metal or other high energy fuel components;

4. Nitroguanidine (NQ);

5. Compounds composed of fluorine and any of the following: other halogens, oxygen, nitrogen;

6. Carboranes; decarborane; pentaborane and derivatives thereof;

7. Cyclotetramethylenetetranitramine (HMX);

octahydro—1,3,5,7—tetranitro—1,3,5,7—tetrazine;

1,3,5,7—tetranitro—1,3,5,7—tetrazacyclooctane; (octogen, octogene);

8. Hexanitrostilbene (HNS);

9. Diaminotrinitrobenzene (DATB);

10. Triaminotrinitrobenzene (TATB);

11. Triaminoguanidinenitrate (TAGN);

12. Titanium subhydride of stoichiometry TiH 0·65–1·68;

13. Dinitroglycoluril (DNGU, DINGU); tetranitroglycoluril (TNGU, SORGUYL);

14. Tetranitrobenzotriazolobenzotriazole (TACOT);

15. Diaminohexanitrobiphenyl (DIPAM);

16. Picrylaminodinitropyridine (PYX);

17. 3—Nitro—1,2,4—triazol—5—one (NTO or ONTA);

18. Hydrazine in concentrations of 70% or more; hydrazine nitrate; hydrazine perchlorates; unsymmetrical dimethyl hydrazine; monomethyl hydrazine; symmetrical dimethyl hydrazine;

19. Ammonium perchlorate;

20. Cyclotrimethylenetrinitramine (RDX); cyclonite; T4; hexahydro—1,3,5—trinitro—1,3,5—triazine; 1,3,5—trinitro—1,3,5—triaza—cyclohexane (hexogen, hexogene);

21. Hydroxylammonium nitrate (HAN); hydroxylammonium perchlorate (HAP);

22. 2—(5—Cyanotetrazolato) pentaamminecobalt(III)perchlorate (or CP);

23. Cis—bis (5—nitrotetrazolato)pentaamminecobalt(III)perchlorate (or BNCP);

24. 7—Amino—4, 6—dinitrobenzofurazane—1—oxide (ADNBF); amino dinitrobenzo—furoxan;

25. 5,7—Diamino—4,6—dinitrobenzofurazane—1—oxide, (CL—14 or diamino dinitrobenzofurozan);

26. 2,4,6—Trinitro—2,4,6—triazacyclohexanone (K—6 or Keto—RDX);

27. 2,4,6,8—Tetranitro—2,4,6,8—tetraazabicyclo[3,3,0]octan—3—one (tetranitrosemiglycouril, K—55 or keto—bicyclic HMX);

28. 1,1,3—Trinitroazetidine (TNAZ);

29. 1,4,5,8—Tetranitro—1,4,5,8—tetraazadecalin (TNAD);

30. Hexanitrohexaazaisowurtzitane (CL—20 or HNIW; and clathrates of CL—20);

31. Polynitrocubanes with more than four nitro groups;

32. Ammonium dinitramide (ADN or SR 12);

(b) Explosives and propellants that meet the following performance parameters:

1. Any explosive with a detonation velocity exceeding 8,700 m/s or a detonation pressure exceeding 340 kilobars;

2. Other organic high explosives not listed elsewhere in this entry yielding detonation pressures of 250 kilobars or more that will remain stable at temperatures of 523 K (250°C) or higher for periods of 5 minutes or longer;

3. Any other United Nations (UN) Class 1·1 solid propellant not listed elsewhere in this entry with a theoretical specific impulse (under standard conditions) of more than 250 seconds for non—metallised, or more than 270 seconds for aluminised compositions;

4. Any UN Class 1·3 solid propellant with a theoretical specific impulse of more than 230 seconds for non—halogenised, 250 seconds for non—metallised and 266 seconds for metallised compositions;

5. Any other gun propellants not listed elsewhere in this entry having a force constant of more than 1,200 kJ/kg;

6. Any other explosive, propellant or pyrotechnic not listed elsewhere in this entry that can sustain a steady—state burning rate of more than 38 mm per second under standard conditions of 68—9 bar pressure and 294 K (21°C);

7. Elastomer modified cast double based propellants (EMCDB) with extensibility at maximum stress of more than 5— at 233K (−40°C);

(c) **Military pyrotechnics;**

(d) Military high—energy solid or liquid fuels, including aircraft fuels specially formulated for military purposes and liquid oxidisers comprised of or containing inhibited red fuming nitric acid (IRFNA) or oxygen difluoride;

Note: This sub—head includes military materials containing thickeners for hydrocarbon fuels specially formulated for use in flamethrowers or incendiary munitions, such as metal stearates or palmates (also known as octol) and M1, M2, M3 thickeners.

(e) Additives, precursors and stabilisers, the following:

1. Azidomethylmethyloxetane (AMMO) and its polymers;

2. Basic copper salicylate; lead salicylate;

3. Bis (2,2—dinitropropyl) formal or bis (2,2—dinitropropyl) acetal;

4. Bis (2—fluoro—2,2—dinitroethyl) formal (FEFO);

5. Bis (2—hydroxyethyl) glycolamide (BHEGA);

6. Bis (2—methylaziridinyl) methylaminophosphine oxide (Methyl BAPO);

7. Bisazidomethyloxetane and its polymers;

8. Bischloromethyloxetane (BCMO);

9. Butadienenitrileoxide (BNO);

10. Butanetrioltrinitrate (BTTN);

11. Catocene, N—butyl—ferrocene and other ferrocene derivatives;

12. Cyanoethylated polyamine and its salts;

13. Cyanoethylated polyamine adducted with glycidol and salt;

14. Dinitroazetidine—t—butyl salt;

15. Energetic monomers, plasticisers and polymers containing nitro, azido, nitrate, nitraza or difluoroamino groups;

16. Poly—2,2,3,3,4,4—hexafluoropentane—1,5—diol formal (FPF—1);

17. Poly—2,4,4,5,5,6,6—heptafluoro—2—trifluoromethyl—3—oxaheptane—1,7— diol formal (FPF—3);

18. Glycidylazide Polymer (GAP) and its derivatives;

19. Guanidine nitrate;

20. Hexabenzylhexaazaisowurtzitane (HBIW);

21. Hexanitrostibene;

22. Hydroxyl terminated polybutadiene (HTPB) with a hydroxyl functionality of less than 2.16, a hydroxyl value of less than 0·77meq/g, and a viscosity at 30°C of less than 47 poise;

23. Hydrogen peroxide in concentrations of greater than 85%;

24. Superfine iron oxide (Fe_20_3 hematite) with a specific surface area more than $250m^2/g$ and an average particle size of 0·003 micrometre or less;

25. Lead beta—resorcylate;

26. Lead stannate, lead maleate, lead citrate;

27. Lead—copper chelates of beta—resorcylate or salicylates;

28. Nitratomethylmethyloxetane or poly (3—Nitratomethyl, 3—methyl oxetane); (Poly—NIMMO) (NMMO);

29. N—methyl—p—nitroaniline;

30. Organo—metallic coupling agents, specifically:

(a) Neopentyl [diallyl] oxy, tri [dioctyl] phosphato titanate; also known as titanium IV, 2,2 [bis 2—propenolato—methyl, butanolate or tris [dioctyl] phosphato—O], or LICA 12;

(b) Titanium IV, [(2—propenolato—1)methyl, N—propanolatomethyl]butanolato—1, also known as tris(dioctyl)pyrophosphato or KR3538;

(c) Titanium IV, [(2—propenolato—1)methyl, N—propanolatomethyl]butanolato—1, also known as tris(dioctyl)phosphate or KR3512;

31. Polycyanodifluoroaminoethyleneoxide (PCDE);

32. Polyfunctional aziridine amides: with isophthalic, trimesic (BITA); butylene imine trimesamide isocyanuric; or trimethyladipic backbone structures and2—methyl or 2—ethyl substitutions on the aziridine ring;

33. Polyglycidylnitrate or poly (nitratomethyl oxirane); (Poly—GLYN) (PGN);

34. Polynitroorthocarbonates;

35. Propyleneimide, 2—methylaziridine;

36. Tetraacetyldibenzylhexaazaisowurtzitane (TAIW);

37. Tetraethylenepentamineacrylonitrile (TEPAN); cyanoethylated polyamine and its salts;

38. Tetraethylenepentamineacrylonitrileglycidol (TEPANOL); cyanoethylated polyamine adducted with glycidol and its salts;

39. Triphenyl bismuth (TPB);

40. Tris vinoxy propane adduct (TVOPA);

41. Tris—1—(2—methyl)aziridinyl phosphine oxide (MAPO); bis(2—methylaziridinyl) 2—(2—hydroxypropanoxy) propylamino phosphine oxide (BOBBA8); and other MAPO derivatives;

42. 1,2,3—Tris [1,2—bis(difluoroamino)ethoxy] propane; tris vinoxy propane adduct (TVOPA);

43. 1,3,5—Trichlorobenzene;

44. 1,2,4—Trihydroxybutane (1,2,4—butanetriol);

45. 1,3,5,7—Tetraacetyl—1,3,5,7—tetraazacyclooctane (TAT);

46. 1,4,5,8—Tetraazadecalin;

47. Low (less than 10,000) molecular weight, alcohol—functionalised, poly (epichlorohydrin); poly (epichlorohydrindiol) and triol.

ML9

Vessels of war and special naval equipment and accessories, as follows, and specially designed components therefor(**3**):

(a) Combatant vessels or vessels (surface or underwater) specially designed or modified for offensive or defensive action, whether or not converted to non—military use, regardless of current state of repair or operating condition, and whether or not they contain weapon delivery systems or armour, and hulls or parts of hulls for such vessels;

(b) Engines, as follows:

1. Diesel engines specially designed for submarines with both of the following characteristics:

(**3**) See also PL 5029.

a. A power output of 1.12MW (1,500hp) or more;

A rotary speed of 700rev/min or more;

2. Electric motors, specially designed for submarines, having all of the following characteristics:

a. A power output of more than 0.75MW (1,000hp);

Quick reversing;

Liquid cooled; and

Totally enclosed;

3. Non—magnetic diesel engines specially designed for military use with a power output of 37·3kW (50hp) or more and with a non—magnetic content in excess of 75% of total mass;

(c) Underwater detection devices specially designed for military use and controls thereof;

(d) Submarine and torpedo nets;

(e) Equipment for guidance and navigation specially designed for military use;

(f) Hull penetrators and connectors specially designed for military use that enable interaction with equipment external to a vessel;

(g) Silent bearings specially designed for military use and equipment containing those bearings.

PL 5029

Nuclear power generating or propulsion equipment, including **nuclear reactors,** specially designed for military use.

ML10

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

(a) Combat **aircraft** and specially designed components therefor;

(b) Other **aircraft** specially designed or modified for military use, including military reconnaissance, assault, military training, transporting and airdropping troops or military equipment, logistics support, and specially designed components therefor;

(c) Aero—engines specially designed or modified for military use, and specially designed components therefor;

(d) Unmanned airborne vehicles, including remotely piloted air vehicles (RPVs), and autonomous, programmable vehicles specially designed or modified for military use, and their launchers, ground support and associated equipment for command and control;

(e) Airborne equipment, including airborne refuelling equipment, specially designed for use with the **aircraft** specified in heads a. or b. above or the aero—engines specified in head c. above, and specially designed components therefor;

(e) Pressure refuellers, pressure refuelling equipment, equipment specially designed to facilitate operations in confined areas and ground equipment, developed specially for **aircraft** specified in heads a. or b. above, or for aero—engines specified in head c. above;

(g) Pressurised breathing equipment and partial pressure suits for use in **aircraft,** anti—g suits, military crash helmets and protective masks, liquid oxygen converters used for

aircraft or missiles, and catapults and cartridge actuated devices for emergency escape of personnel from **aircraft;**

(h) Parachutes used for combat personnel, cargo dropping or aircraft deceleration, as follows:

1. Parachutes for:

   a. Pin point dropping of military personnel;

   Dropping of paratroopers;

2. Cargo parachutes;

3. Paragliders (drag parachutes, drogue parachutes for stabilisation and attitude control of dropping bodies, e.g., recovery capsules, ejection seats, bombs);

4. Drogue parachutes for use with ejection seat systems for deployment and inflation sequence regulation of emergency parachutes;

5. Recovery parachutes for guided missiles, drones or space vehicles;

6. Approach parachutes and landing deceleration parachutes;

7. Other military parachutes;

(i) Automatic piloting systems for parachuted loads; equipment specially designed or modified for military use for controlled opening jumps at any height, including oxygen equipment.

ML11

Electronic equipment not specified elsewhere in this Group specially designed for military use and specially designed components therefor.

ML13

Armoured or protective equipment and constructions, as follows:

(a) Armoured plate;

(b) Combinations and constructions of metallic and non—metallic materials specially designed to provide ballistic protection for military systems;

(c) Military helmets;

except:

Conventional steel helmets not equipped with, modified or designed to accept any type of accessory device;

(d) Body armour, bullet—proof or bullet—resistant clothing, flack suits and specially designed components therefor;

except:

Equipment specially designed for protection against knife attacks or other equipment primarily designed for protection whilst playing sport.

PL5014

Specially designed components for the **goods** specified in heads a., b. or c. of entry ML13 in this Group.

ML14

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

ML15

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

(a) Recorders and image processing equipment;

(b) Cameras, photographic equipment and film processing equipment;

(c) Image intensifier equipment;

except:

First generation image intensifier tubes;

(d) Infrared or thermal imaging equipment;

(e) Imaging radar sensor equipment;

(e) Countermeasure or counter—countermeasure equipment for the equipment specified in heads a. to e. above.

ML16

Forgings, castings and semi—finished products specially designed for **goods** specified in entries ML1, ML2, ML3, ML4, ML6, ML10, ML23 or ML26.

PL5020

Forgings, castings and semi—finished products specially designed for **goods** specified in entries PL5006 or PL5018.

ML17

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

(a) Self—contained diving and underwater swimming apparatus, as follows:

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

(b) Construction equipment specially designed for military use;

(c) Fittings, coatings and treatments for signature suppression, specially designed for military use;

(d) Field engineer equipment specially designed for use in a combat zone;

(e) **Robots, robot** controllers and **robot end effectors,** having any of the following characteristics:

1. Specially designed for military use;

2. Incorporating means of protecting hydraulic lines against externally induced punctures caused by ballistic fragments and designed to use hydraulic fluids with flash points higher than 839 K (566°C);
3. Operable at altitudes exceeding 30,000m; or
4. Specially designed or rated for operating in an electro—magnetic pulse (EMP) environment;

(e) Libraries (parametric technical databases) specially designed for military use with **goods** specified in this Group.

In this entry `libraries' are collections of technical information of a military nature, reference to which may enhance the performance of military equipment or software.

ML18

Equipment and **technology** for the **production** of **goods** specified in this Group, as follows:

(a) Specially designed or modified production equipment for the production of products specified in this Group and specially designed components therefor;

(b) Specially designed environmental test facilities, and specially designed equipment therefor, for the certification, qualification, or testing of products specified in this Group;

(c) Production technology, even if the equipment with which such technology is to be used is not specified in this Group;

(d) Technology specific to the design of, the assembly of components into, and the operation, maintenance and repair of, complete production installations even if the components themselves are not specified in this Group.

PL 5017

Equipment for the development of the goods specified in this Group.

ML20

Cryogenic and superconductive equipment, as follows, and specially designed components and accessories therefor:

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

(b) Superconductive electrical equipment (rotating machinery and transformers) specially designed or configured to be installed in a vehicle for military ground, marine, airborne or space applications and capable of operating while in motion;

except:

Direct—current hybrid homopolar generators that have single—pole normal metal armatures which rotate in a magnetic field produced by superconducting windings, provided those windings are the only superconducting component in the generator.

ML23

Directed energy weapons (DEW) systems, related or countermeasure equipment and test models, as follows, and specially designed components therefor:

(a) Laser systems specially designed for destruction or effecting mission—abort of a target;

(b) Particle beam systems capable of destruction or effecting mission—abort of a target;

(c) High power radio—frequency (RF) systems capable of destruction or effecting mission —abort of a target;

(d) Equipment specially designed for the detection or identification of, or defence against, systems specified in heads a., b. or c. above;

(e) Physical test models and related test results for the systems, equipment and components specified in heads a. to d. above.

ML24

Software, as follows:

(a) Software specially designed or modified for the development, production, or use of equipment or material specified in this Group;

(b) Specific software, as follows:

1. Software specially designed for:

a. Modelling, simulation or evaluation of military weapon systems;

b. Development, monitoring, maintenance or up—dating of software embedded in military weapon systems;

c. Modelling or simulating military operation scenarios, not specified in entry ML14 in this Group;

d. Command, Communications, Control and Intelligence ($C_3$3I) applications;

2. Software for determining the effects of conventional, nuclear, chemical or biological warfare weapons.

ML26

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

(a) Kinetic energy weapons systems specially designed for destruction or effecting mission —abort of a target;

(b) Specially designed test and evaluation facilities and test models, including diagnostic instrumentation and targets, for dynamic testing of kinetic energy projectiles and systems.

PL5001

Security and para—military police equipment, as follows:

(a) Acoustic devices represented by the manufacturers or suppliers thereof as suitable for riot control purposes, and specialised components therefor;

(b) Anti—riot shields and components therefor;

(c) Leg—irons, shackles (excluding any pair of handcuffs the maximum dimension of which when locked does not exceed 240mm) and gangchains, specially designed for restraining human beings;

(d) Portable anti—riot devices for administering an electric shock or an incapacitating substance, and specialised components therefor;

(e) Water cannon and components therefor;

(e) Riot control vehicles which have been specially designed or modified to be electrified to repel boarders.

PL5027

Technology applicable to the development or use of goods specified in entries ML11, ML18, PL5017, heads a. or b. of entry ML4, heads a. or b. of entry ML5, head j. of entry ML6, heads a., b. or c. of entry ML10, or heads a., b., d. or e. of entry ML8 of this Group.

PL5028

The export of goods specified in this entry is only prohibited to any destination in any country listed in Schedule 2.

Technology applicable to the development or use of goods specified in this Group other than that specified in PL5027.

GROUP 2

ATOMIC ENERGY MINERALS AND MATERIALS AND NUCLEAR FACILITIES, EQUIPMENT, APPLIANCES AND SOFTWARE

Definitions

In this Group:

"boron equivalent" (BE) is defined as:

$$BE = CF \times \text{Concentration of element Z in ppm}$$

where CF is the conversion factor

$$= \frac{\gamma_Z \times A_B}{\gamma_B \times A_Z}$$

and γB and γZ are the thermal cross sections (in barns) for boron and element Z respectively;

and AB and AZ are the atomic weights of boron and element Z respectively;

"depleted uranium" means uranium depleted in the isotope 235 below that occurring in nature;

"effective gramme" of special fissile material or other fissile material means:

a. for plutonium isotopes and uranium—233, the isotope weight in grammes;

b. for uranium enriched 1 per cent or greater in the isotope U—235, the element weight in grammes multiplied by the square of its enrichment expressed as a decimal weight fraction;

c. for uranium enriched below 1 per cent in the isotope U—235, the element weight in grammes multiplied by 0·0001;

d. for americium—242m, curium—245 and —247, californium—249 and —251, the isotope weight in grammes multiplied by 10;

"fibrous or filamentary materials" include:

a. continuous monofilaments;

b. continuous yarns and rovings;

c. tapes, fabrics, random mats and braids;

d. chopped fibres, staple fibres and coherent fibre blankets;

e. whiskers, either monocrystalline or polycrystalline, of any length;

e. aromatic polyamide pulp;

a “laser” is an assembly of components which produce both spatially and temporally coherent light which is amplified by stimulated emission of radiation;

“natural uranium” means uranium containing the mixtures of isotopes occurring in nature;

“nuclear reactor” means the items within or attached directly to the reactor vessel, the equipment which controls the level of power in the core, and the components which normally contain, come into direct contact with or control the primary coolant of the reactor core;

“other fissile materials” means previously separated americium—242m, curium—245 and —247, californium—249 and —251, isotopes of plutonium other than plutonium—238 and —239, and any material containing the foregoing;

“previously separated” means the application of any process intended to increase the concentration of the controlled isotope;

“special fissile material” means plutonium—239, uranium—233, uranium enriched in the isotopes 235 or 233, and any material containing the foregoing;

“specific modulus” is Young’s modulus in pascals, equivalent to N/m^2 divided by specific weight in N/m^3, measured at a temperature of (296 ± 2) K ((23 ± 2)°C) and a relative humidity of (50 ± 5)%;

“specific tensile strength” is ultimate tensile strength in pascals, equivalent to N/m^2 divided by specific weight in N/m^3, measured at a temperature of (296 ± 2) K ((23 ± 2)°C) and a relative humidity of (50 ± 5)%;

“uranium enriched in the isotopes 235 or 233” means uranium containing the isotopes 235 or 233, or both, in an amount such that the abundance ratio of the sum of these isotopes to the isotope 238 is more than the ratio of the isotope 235 to the isotope 238 occurring in nature (isotopic ratio 0·72%).

Atomic Energy Minerals and Materials

2A

A10

Natural uranium or depleted uranium or thorium, in the form of metal, alloy, chemical compound, or concentrate and any other material containing one or more of the foregoing;

except:

(a) Four grammes or less of natural uranium or depleted uranium when contained in a sensing component in instruments;

(b) Depleted uranium specially fabricated for the following civil non—nuclear applications:

1. Shielding;
2. Packaging;
3. Ballasts;
4. Counter—weights.

A20

Special fissile materials and other fissile materials;

except:

Four effective grammes or less when contained in a sensing component in instruments.

A30

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

except:

b. Three grammes or less when contained in a sensing component in instruments;

c. Previously separated neptunium—237 in any form;

except:

Shipments with a neptunium—237 content of one gramme or less.

A40

Deuterium, heavy water, deuterated paraffins and other compounds of deuterium, and mixtures and solutions containing deuterium, in which the isotopic ratio of deuterium to hydrogen exceeds 1:5,000.

A50

Graphite, nuclear—grade, having a purity level of less than 5 parts per million boron equivalent and with a density greater than 1·5g/cm^3.

A60

Nickel powder and porous nickel metal, as follows:

(a) Powder with a nickel purity content of 99·9 weight % or more and a mean particle size of less than 10 micrometres measured by American Society for Testing and Materials (ASTM) B330 standard and a high degree of particle size uniformity;

(b) Porous nickel metal produced from materials specified in head a. above;

except:

Single porous nickel sheets not exceeding 930cm^2 intended for use in batteries for civil applications.

A70

Specially prepared compounds or powders, other than nickel, resistant to corrosion by UF_6 (egaluminium oxide and fully fluorinated hydrocarbon polymers), for the manufacture of gaseous diffusion barriers, having a purity content of 99·9 weight % or more and a mean particle size of less than 10 micrometres measured by American Society for Testing and Materials (ASTM) B330 standard and a high degree of particle size uniformity.

Nuclear Facilities, Equipment, Appliances and Software

2B

B10

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

(a) Plant specially designed for separating isotopes of natural uranium, depleted uranium, special fissile materials or other fissile materials, as follows:

1. Gaseous diffusion separation plant;
2. Gas centrifuge separation plant;
3. Aerodynamic separation plant;
4. Chemical exchange separation plant;
5. Ion—exchange separation plant;
6. Atomic vapour laser isotopic separation plant;
7. Molecular laser isotopic separation plant;
8. Plasma separation plant;
9. Electromagnetic separation plant;

(b) Equipment and components, as follows, specially designed or prepared for:

1. Gaseous diffusion separation process:

a. Valves wholly made of or lined with aluminium, aluminium alloys, nickel or alloy containing 60 weight % or more nickel, 40mm or more in diameter, with bellows seals;

b. Blowers and compressors (turbo, centrifugal and axial flow types) wholly made of or lined with materials resistant to UF_6 (egaluminium, aluminium alloys, nickel or alloy containing 60 weight % or more nickel), having a capacity of 1,000 litres per minute or more, and seals therefor designed for a buffer gas in—leakage rate of less than 1,000cm^3/min;

c. Gaseous diffusion barriers made of porous metallic, polymer or ceramic materials resistant to corrosion by UF_6 with a pore size of less than 100nm, a thickness of 5mm or less, and, for tubular forms, a diameter of 25mm or less;

d. Gaseous diffuser housings;

e. Heat exchangers made of aluminium, copper, nickel or alloys containing more than 60 weight % nickel, or combinations of these metals as clad tubes, designed to operate at sub—atmospheric pressure with a leak rate that limits the pressure rise to less than 10Pa per hour under a pressure differential of 100kPa;

(2) Gas centrifuge separation process:

(a) Gas centrifuges;

(b) Complete rotor assemblies;

(c) Rotor tube cylinders with a thickness of 12mm or less, a diameter of between 75mm and 400mm, made from any of the following high strength—to—density ratio materials:

(1) Maraging steel capable of an ultimate tensile strength of 2,050MPa or more;

(2) Aluminium alloys capable of an ultimate tensile strength of 460MPa or more; or

(3) Fibrous or filamentary materials with a specific modulus of more than $3{\cdot}18 \times 10^6$m and a specific tensile strength greater than $76{\cdot}2 \times 10^3$m;

(d) Magnetic suspension bearings consisting of an annular magnet suspended within a housing containing a damping medium, and having the magnet coupling with a pole piece or second magnet fitted to the top cap of the rotor;

(e) Specially prepared bearings comprising a pivot—cup assembly mounted on a damper;

(e) Rings or bellows with a wall thickness of 3mm or less and a diameter of between 75mm and 400mm and designed to give local support to a rotor tube or to join a number together, made from any of the following high strength—to—density ratio materials:

(1) Maraging steel capable of an ultimate tensile strength of 2,050MPa or more;

(2) Aluminium alloys capable of an ultimate tensile strength of 460MPa or more; or

(3) Fibrous or filamentary materials with a specific modulus of more than $3{\cdot}18 \times 10^6$m and a specific tensile strength greater than $76{\cdot}2 \times 10^3$m;

(g) Baffles of between 75mm and 400mm diameter for mounting inside a rotor tube, made from any of the following high strength—to—density ratio materials:

(1) Maraging steel capable of an ultimate tensile strength of 2,050MPa or more;

(2) Aluminium alloys capable of an ultimate tensile strength of 460MPa or more; or

(3) Fibrous or filamentary materials with a specific modulus of more than $3{\cdot}18 \times 10^6$ m and a specific tensile strength greater than $76{\cdot}2 \times 10^3$ m;

(h) Top and bottom caps of between 75mm and 400mm diameter to fit the ends of a rotor tube, made from any of the following high strength—to—density ratio materials:

(1) Maraging steel capable of an ultimate tensile strength of 2,050MPa or more;

(2) Aluminium alloys capable of an ultimate tensile strength of 460MPa or more; or

(3) Fibrous and filamentary materials with a specific modulus of more than $3{\cdot}18 \times 10^6$ m and a specific tensile strength greater than $76{\cdot}2 \times 10^3$ m;

(i) Molecular pumps comprised of cylinders having internally machined or extruded helical grooves and internally machined bores;

(j) Ring—shaped motor stators for multiphase AC hysteresis (or reluctance) motors for synchronous operation within a vacuum in the frequency range of 600 to 2,000 Hz and a power range of 50 to 1,000 Volt—Amps;

(k) Frequency changers (converters or inverters) specially designed or prepared to supply motor stators for gas centrifuge enrichment, having all of the following characteristics, and specially designed components therefor:

(1) Multiphase output of 600 Hz to 2 kHz;

(2) Frequency control better than 0·1%;

(3) Harmonic distortion of less than 2%; and

(4) An efficiency greater than 80%;

(3) Aerodynamic separation process:

(a) Separation nozzles consisting of slit—shaped, curved channels having a radius of curvature less than 1 mm and having a knife—edge contained within the nozzle which separates the gas flowing through the nozzle into two streams;

(b) Tangential inlet flow—driven cylindrical or conical tubes, specially designed for uranium isotope separation;

(c) UF_6—hydrogen helium compressors wholly made of or lined with aluminium, aluminium alloys, nickel or alloy contained 60 weight % or more nickel, including compressor seals;

(d) Aerodynamic separation element housings, designed to contain vortex tubes or separation nozzles;

(e) Heat exchangers made of aluminium, copper, nickel, or alloys containing more than 60 weight % nickel, or combinations of these metals as clad tubes, designed to operate at pressures of 600 kPa or less;

(4) Chemical exchange separation process:

(a) Fast—exchange liquid—liquid centrifugal contactors or fast exchange liquid—liquid pulse columns made of fluorocarbon lined materials;

(b) Electrochemical reduction cells designed to reduce uranium from one valence state to another;

(5) Ion—exchange separation process including fast reacting ion—exchange resins, pellicular and reticulated resins in which the active chemical exchange groups are limited to a coating on the surface of an inert particle or fibre;

(6) Atomic vapour laser isotopic separation process:

(a) High power electron beam guns with total power of more than 50 kW and strip or scanning electron beam guns with a delivered power of more than 2·5 kW/cm for use in uranium vaporization systems;

(b) Trough shaped crucible and cooling equipment for molten uranium;

(c) Product and tails collector systems made of or lined with materials resistant to the heat and corrosion of uranium vapour, such as yttria—coated graphite;

(7) Molecular laser isotopic separation process:

(a) Supersonic expansion nozzles designed for UF_6 carrier gas;

(b) Uranium fluoride (UF_5) product filter collectors;

(c) Equipment for fluorinating UF_5 to UF_6;

(d) UF_6 carrier gas compressors wholly made of or lined with aluminium, aluminium alloys, nickel or alloy containing 60 weight % or more nickel, including compressor seals;

(8) Plasma separation process:

(a) Product and tails collectors made of or lined with materials resistant to the heat and corrosion of uranium vapour such as yttria—coated graphite;

(b) Radio frequency ion excitation coils for frequencies of more than 100 kHz and capable of handling more than 40 kW power.

B20

Specially designed or prepared auxiliary systems, equipment and components, as follows, for gas centrifuge or gaseous diffusion enrichment plants, made from or lined with UF_6 resistant materials:

(a) Feed autoclaves, for passing UF^6 to gaseous diffusion or centrifuge cascades, capable of operating at pressures of 300 kPa or less;

(b) Desublimers or cold traps, used to remove UF^6 from gaseous diffusion or centrifuge cascades, capable of operating at pressures of 300 kPa or less;

(c) Product and tails stations for trapping and transferring UF_6 into containers;

(d) Liquefaction stations, where UF_6 gas from gaseous diffusion or centrifuge cascades is compressed and cooled to form liquid UF_6, capable of operating at pressures of 300 kPa or less;

(e) Piping systems and header systems specially designed for handling UF_6 within gaseous diffusion or centrifuge cascades;

(f) Specially designed vacuum manifolds or vacuum headers having a suction capacity of 5 m^3/minute or more or specially designed vacuum pumps;

(g) UF_6 mass spectrometers/ion sources specially designed or prepared for taking on—line samples of feed, product or tails from UF_6 gas streams and having all of the following characteristics:

1. Unit resolution for mass of more than 320 amu;
2. Ion sources constructed of or lined with nichrome or monel, or nickel plated; and
3. Electron bombardment ionization sources.

B30

Plant for the production of uranium hexafluoride (UF_6) and specially designed or prepared equipment and components therefor, as follows:

(a) Plant for the production of UF_6;

(b) Equipment and components, as follows, specially designed or prepared for UF_6 production:

1. Fluorination and hydrofluorination screw and fluid bed reactors and flame towers;
2. Distillation equipment for the purification of UF_6

B40

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

(a) Plant for the production of heavy water, deuterium or deuterium compounds, as follows:

1. Hydrogen sulphide—water exchange plant;
2. Ammonia—hydrogen exchange plant;
3. Hydrogen distillation plant;

(b) Equipment and components, as follows, designed for:

1. Hydrogen sulphide—water exchange process:
    a. Tray exchange towers;
    b. Hydrogen sulphide gas compressors;
2. Ammonia—hydrogen exchange process:
    a. High—pressure ammonia—hydrogen exchange towers;
    b. High—efficiency stage contactors;
    c. Submersible stage recirculation pumps;
    d. Ammonia crackers designed for pressures of more than 3 MPa;
3. Hydrogen distillation process:
    a. Hydrogen cryogenic distillation towers and cold boxes designed for operation below 35 K (−238°C);
    b. Turboexpanders or turboexpander—compressor sets designed for operation below 35 K (−238°C);
4. Heavy water concentration process to reactor grade level (99·75 weight % deuterium oxide):
    a. Water distillation towers containing specially designed packings;

b. Ammonia distillation towers containing specially designed packings;

c. Catalytic burners for conversion of fully enriched deuterium to heavy water;

d. Infrared absorption analysers capable of on—line hydrogen—deuterium ratio analysis where deuterium concentrations are equal to or more than 90 weight %.

B50

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

(a) Pressure vessels, i.e., metal vessels as complete units or parts therefor, which are specially designed or prepared to contain the core of a nuclear reactor and are capable of withstanding the operating pressure of the primary coolant, including the top plate for a reactor pressure vessel;

(b) Fuel element handling equipment, including reactor fuel charging and discharging machines;

(c) Control rods specially designed or prepared for the control of the reaction rate in a nuclear reactor, including the neutron absorbing part and the support or suspension structures therefor, and control rod guide tubes;

(d) Electronic controls for controlling the power levels in nuclear reactors, including reactor control rod drive mechanisms and radiation detection and measuring instruments to determine neutron flux levels;

(e) Pressure tubes specially designed or prepared to contain fuel elements and the primary coolant in a nuclear reactor at an operating pressure in excess of 5·1 MPa;

(f) Tubes, or assemblies of tubes, made from zirconium metal or alloy in which the ratio of hafnium to zirconium is less than 1:500 parts by weight, specially designed or prepared for use in a nuclear reactor;

(g) Coolant pumps specially designed or prepared for circulating the primary coolant of nuclear reactors;

(h) Internal components specially designed or prepared for the operation of a nuclear reactor, including core support structures, thermal shields, baffles, core grid plates and diffuser plates;

(i) Heat exchangers.

B60

Plant specially designed for the fabrication of nuclear reactor fuel elements and specially designed equipment therefor.

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

(a) Normally comes into direct contact with or directly processes or controls the production flow of nuclear materials;

(b) Seals the nuclear material within the cladding;

(c) Checks the integrity of the cladding or the seal; and

(d) Checks the finish treatment of the solid fuel.

B70

Plant for the reprocessing of irradiated nuclear reactor fuel elements, and specially designed or prepared equipment and components therefore, including:

(a) Fuel element chopping or shredding machines, i.e., remotely operated equipment to cut, chop, shred or shear irradiated nuclear reactor fuel assemblies, bundles or rods;

(b) Dissolvers, critically safe tanks (e.g., small diameter, annular or slab tanks) specially designed or prepared for the dissolution of irradiated nuclear reactor fuel, which are capable of withstanding hot, highly corrosive liquids, and which can be remotely loaded and maintained;

(c) Counter—current solvent extractors and ion—exchange processing equipment, specially designed or prepared for use in a plant for the reprocessing of irradiated natural uranium, depleted uranium, special fissile materials or other fissile materials;

(d) Process control instrumentation specially designed or prepared for monitoring or controlling the reprocessing of irradiated natural uranium, depleted uranium, special fissile materials or other fissile materials;

(e) Holding or storage vessels specially designed to be critically safe and resistant to the corrosive effects of nitric acid;

(f) Systems specially designed or prepared for the conversion of plutonium nitrate to plutonium oxide;

(g) Systems specially designed or prepared for the production of plutonium metal.

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

B80

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

Note: This entry does not apply to conventional power generating equipment which, although designed for use in a particular nuclear station, could in principle be used in conjunction with conventional systems.

B90

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

(a) Packed liquid—liquid exchange columns specially designed for lithium amalgams;

(b) Amalgam pumps;

(c) Amalgam electrolysis cells;

(d) Evaporators for concentrated lithium hydroxide solution.

B100

Equipment for nuclear reactors, as follows:

(a) Simulators specially designed for nuclear reactors;

(b) Ultrasonic or eddy current test equipment specially designed for nuclear reactors.

B110

Software specially designed or modified for the development, production or use of equipment or materials specified in this Group.

E10

The export of goods specified in this entry is only prohibited to any destination in any country listed in Schedule 2.

Technology applicable to the development, production or use of goods specified in entries A30, B30, B80 to B110, head b. of entry A60, sub—heads b.4. to b.8. of entry B10,head d. of entry B50, head i. of entry B50, or head d. of entry B70 in this Group.

E20

Technology applicable to the development, production or use of goods specified in this Group other than that specified in entry E10.

GROUP 3

DUAL—USE INDUSTRIAL GOODS AND TECHNOLOGY NOT SPECIFIED INGROUPS 1 OR 2

Exclusions and definitions

1. This Group does not specify software which is either:

(a) generally available to the public or

(b)

(1) sold from stock at retail selling points, without restriction, by means of:

(a) over—the—counter transactions;

(b) mail order transactions;

(c) telephone order transactions; and

(2) is designed for installation by the user without further substantial support by the supplier.

2. In this Group:

"2—D vector rate" means the number of vectors generated per second which have 10 pixel poly line vectors, clip tested, randomly oriented, with either integer or floating point X—Y coordinate values, whichever produces the maximum rate;

"3—D vector rate" means the number of vectors generated per second which have 10 pixel poly line vectors, clip tested, randomly oriented, with either integer or floating point X—Y—Z coordinate values, whichever produces the maximum rate;

"accuracy", usually measured in terms of inaccuracy, means the maximum deviation, positive or negative, of an indicated value from an accepted standard or true value;

"active flight control systems" are systems whose function is to prevent undesirable aircraft motions, rocket motions or structural loads by autonomously processing outputs from multiple sensors and then providing necessary preventive commands to effect automatic control;

"active pixel" is a minimum (single) element of the solid state array which has a photoelectric transfer function when exposed to light;

"adaptive control" means a control system that adjusts the response from conditions detected during the operation;

"angular position deviation" means the maximum difference between angular position and the actual, very accurately measured angular position, after the workpiece mount of the table has been turned out of its initial position;

"ASTM" means the American Society for Testing and Materials;

"asynchronous transfer mode" (ATM) means a transfer mode in which the information is organised into cells; it is asynchronous in the sense that the recurrence of cells depends on the required or instantaneous bit rate;

"automatic target tracking" means a processing technique that automatically determines and provides as output an extrapolated value of the most probable position of the target in real time;

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

"basic gate propagation delay time" means the propagation delay time value corresponding to the basic gate used within a family of monolithic integrated circuits; this may be specified, for a given family, either as the propagation delay time per typical gate or as the typical propagation delay time per gate;

"beat length" means the distance over which two orthogonally polarised signals, initially in phase, must pass in order to achieve a 2 Pi radian(s) phase difference;

"bias" means an accelerometer output when no acceleration is applied;

"camming" (axial displacement) means axial displacement in one revolution of the main spindle measured in a plane perpendicular to the spindle faceplate, at a point next to the circumference of the spindle faceplate;

"CCITT" means International Telegraph and Telephone Consultative Committee;

"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;

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

"circuit element" means a single active or passive functional part of an electronic circuit which may be a diode, a transistor, a resistor or a capacitor;

"circulation—controlled anti—torque or circulation—controlled directional control systems" are systems that use air blown over aerodynamic surfaces to increase or control the forces generated by the surfaces;

"commingled" means the filament to filament blending of thermoplastic fibres and reinforcement fibres in order to produce a fibre reinforcement/matrix mix in total fibre form;

"comminution" means a process to reduce a material to particles by crushing or grinding;

"common channel signalling" is a signalling method in which a single channel between exchanges conveys, by means of labelled messages, signalling information relating to a multiplicity of circuits or calls and other information such as that used for network management;

"communications channel controller" means the physical interface which controls the flow of synchronous or asynchronous digital information; it is an assembly that can be integrated into computer or telecommunications equipment to provide communications access;

a "composite" means a matrix and an additional phase or additional phases consisting of particles, whiskers, fibres or any combination thereof, present for a specific purpose or purposes;

“composite theoretical performance” (CTP) is a measure of computational performance given in millions of theoretical operations per second (Mtops), calculated using the aggregation of computing elements (CE);

“compound rotary table” means a table allowing the workpiece to rotate and tilt about two non —parallel axes, which can be coordinated simultaneously for contouring control;

“computing element” (CE) means the smallest computational unit that produces an arithmetic or logic result;

“contouring control” means two or more numerically controlled motions operating in accordance with instructions that specify the next required position and the required feed rates to that position; these feed rates are varied in relation to each other so that a desired contour is generated;

the “critical temperature” (sometimes referred to as the transition temperature) of a specific superconductive material means the temperature at which the specific material loses all resistance to the flow of direct electrical current;

“cryptography” means the discipline which embodies principles, means and methods for the transformation of data in order to hide its information content, prevent its undetected modification or prevent its unauthorized use; cryptography is limited to the transformation of information using one or more secret parameters or associated key management; for this purpose, `secret parameter' is a constant or key kept from the knowledge of others or shared only within a group;

“datagram” means a self—contained, independent entity of data carrying sufficient information to be routed from the source to the destination data terminal equipment without reliance on earlier exchanges between this source or destination data terminal equipment and the transporting network;

“data signalling rate” means the maximum one—way rate, ie the maximum rate in either transmission or reception, whichever is the greater, as defined in ITU Recommendation 53 —36, taking into account that, for non—binary modulation, baud and bit per second are not equal; binary digits for coding, checking and synchronisation functions are included;

“deformable mirrors” means mirrors capable of having their optical surface dynamically deformed by individual torques or forces;

“diffusion bonding” means a solid—state molecular joining of at least two separate metals into a single piece with a joint strength equivalent to that of the weakest material;

“digital computer” means equipment which can, in the form of one or more discrete variables:

(a) accept data;

(b) store data or instructions in fixed or alterable (writable) storage devices;

(c) process data by means of a stored sequence of instructions which is modifiable (including by replacement of fixed storage devices, but not by a physical change in wiring or interconnections); and

(d) provide output of data;

“digital transfer rate” means the total bit rate of the information that is directly transferred on any type of medium;

“direct—acting hydraulic pressing” means a deformation process which uses a fluid—filled flexible bladder in direct contact with the workpiece;

“discrete component” means a separately packaged circuit element with its own external connections;

"drift rate", as it relates to gyros, means the time rate of output deviation from the desired output; it consists of random and systematic components and is expressed as an equivalent input angular displacement per unit time with respect to inertial space;

"dynamic adaptive routing" means automatic rerouting of traffic based on sensing and analysis of current actual network conditions;

"dynamic signal analysers" means signal analysers which use digital sampling and transformation techniques to form a Fourier spectrum display of the given waveform including amplitude and phase information;

"electronically steerable phased array antenna" means an antenna which forms a beam by means of phase coupling, where the beam direction is controlled by the complex excitation coefficients of the radiating elements and the direction of that beam can be varied in azimuth or in elevation, or both, by application, both in transmission and reception, of an electrical signal;

"electronic assemblies" mean a number of electronic components (including circuit elements, discrete components and integrated circuits) connected together to perform a specific function, which are replaceable as an entity and are normally capable of being disassembled;

"end—effectors" include grippers, active tooling units and any other tooling that is attached to the baseplate on the end of a robot manipulator arm; for this purpose, `active tooling unit' means a device for applying motive power, process energy or sensing to the workpiece;

"equivalent density" means the mass of an optic per unit optical area projected onto the optical surface;

"expert systems" means systems providing results by application of rules to data which are stored independently of the programme and capable of any of the following:

(a) modifying automatically the source code introduced by the user;

(b) providing knowledge linked to a class of problems in quasi—natural language; or

(c) acquiring the knowledge required for their development (symbolic training);

"family" means a group of microprocessor or microcomputer microcircuits which have:

(a) the same architecture;

(b) the same basic instruction set; and

(c) the same basic technology (e.g., only N—channel Metal Oxide Semiconductor (NMOS) or only Complementary Metal Oxide Semiconductor (CMOS));

"fast select" means a facility applicable to virtual calls which allows a data terminal equipment to expand the possibility of transmitting data in call set—up and clearing packets beyond the basic capabilities of a virtual call; for this purpose, `packet' means a group of binary digits (including call control signals and data) which is switched as a composite whole, the call control signals, data and if present error control information being arranged in a specified format;

"fault tolerance" means the ability of a computer system, after any malfunction of any of its hardware or software components, to continue to operate without human intervention, at a given level of service that provides: continuity of operation, data integrity and recovery of service within a given time;

"fibrous or filamentary materials" include:

(a) continuous monofilaments;

(b) continuous yarns and rovings;

(c) tapes, fabrics, random mats and braids;

(d) chopped fibres, staple fibres and coherent fibre blankets;

(e) whiskers, either monocrystalline or polycrystalline, of any length;

(f) aromatic polyamide pulp;

"film type integrated circuit" means an array of circuit elements and metallic interconnections formed by deposition of a thick or thin film on an insulating substrate;

"fixed", as it relates to information security, means that the coding or compression algorithm cannot accept externally supplied parameters (e.g., cryptographic or key variables) and cannot be modified by the user;

"flexible manufacturing unit" (FMU), (sometimes also referred to as flexible manufacturing system (FMS) or flexible manufacturing cell (FMC)) means a combination of at least:

(a) a digital computer including its own main storage and its own related equipment; and

(b) two or more of the following:

(a) a machine tool specified in head c. of entry 2B001;

(b) a dimensional inspection machine or another digitally controlled measuring machine specified in Category 2;

(c) a robot specified in Categories 2 or 8;

(d) digitally controlled equipment specified in entries 1B003, 2B003 or 9B001;

(e) Stored programme controlled equipment specified in head a. of entry 3B001;

(f) digitally controlled equipment specified in entry 1B001;

(g) digitally controlled electronic equipment specified in head c. of entry 3A002;

"fluoride fibres" means fibres manufactured from bulk fluoride compounds;

"frequency agility" means a system in which the transmission frequency of a single communication channel is made to change by discrete steps (sometimes known as frequency hopping);

"frequency switching time" means the maximum time (i.e.,delay), taken by a signal, when switched from one selected output frequency to another selected output frequency, to reach:

(a) a frequency within 100 Hz of the final frequency; or

(b) an output level within 1 dB of the final output level;

"frequency synthesiser" means any kind of frequency source or signal generator, regardless of the actual technique used, providing a multiplicity of simultaneous or alternative output frequencies, from one or more outputs, controlled by, derived from or disciplined by a lesser number of standard (or master) frequencies;

"gas atomisation" means a process to reduce a molten stream of metal alloy to droplets of500 micrometre diameter or less by a high pressure gas stream;

"gateway" means the function, realised by any combination of equipment and software, to carry out the conversion of conventions for representing, processing or communicating information used in one system into the corresponding but different conventions used in another system;

"generic software" means a set of instructions for a stored programme controlled switching system that is the same for all switches using that type of switching system;

Note: The database portion is not considered to be part of the generic software;

"geographically dispersed" is where each sensor location is distant from any other by more than 1,500 m in any direction; mobile sensors are always considered geographically dispersed;

"global interrupt latency time" means the time taken by a computer system to recognize an interrupt due to an event, service the interrupt and perform a context switch to an alternate memory—resident task waiting on the interrupt;

"guidance set" means systems that integrate the process of measuring and computing a vehicles position and velocity (i.e.,navigation) with that of computing and sending commands to the vehicles flight control systems to correct the trajectory;

"hot isostatic densification" means the process of pressurising a casting at temperatures exceeding 375 K (102°C) in a closed cavity through various media (including gas, liquid or solid particles) to create equal force in all directions to reduce or eliminate internal voids in the casting;

"hybrid computer" means equipment which can:

(a) accept data;

(b) process data, in both analogue and digital representations; and

(c) provide output of data;

"hybrid integrated circuit" means any combination of integrated circuit(s), integrated circuits with circuit elements or discrete components connected together to perform a specific function and having all the following characteristics:

(a) containing at least one unencapsulated device;

(b) connected together using typical integrated circuit production methods;

(c) replaceable as an entity; and

(d) not normally capable of being disassembled;

"image enhancement" means the processing of externally derived information—bearing images by algorithms such as time compression, filtering, extraction, selection, correlation, convolution or transformations between domains (e.g.,fast Fourier transform or Walsh transform); this does not include algorithms using only linear or rotational transformation of a single image, such as translation, feature extraction, registration or false colouration;

"improvised explosive devices" means devices placed or fabricated in an improvised manner incorporating destructive, lethal, noxious, pyrotechnic or incendiary chemicals, designed to destroy, disfigure or harass; they may incorporate military stores, but are normally devised from non—military components;

"information security" is all the means and functions ensuring the accessibility, confidentiality or integrity of information or communications, excluding the means and functions intended to safeguard against malfunctions; this includes cryptography, cryptanalysis, protection against compromising emanations and computer security; for this purpose, `cryptanalysis' is the analysis of a cryptographic system or its inputs and outputs to derive confidential variables or sensitive data, including clear text;

"instantaneous bandwidth" means the bandwidth over which output power remains constant within 3 dB without adjustment of other operating parameters;

"instrumented range" means the specified unambiguous display range of a radar;

"insulation" is applied to the components of a rocket motor, i.e., the case, nozzle, inlets, case closures, and 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;

"Integrated Services Digital Network" (ISDN) means a unified end—to—end digital network, in which data originating from all types of communication (e.g.,voice, text, data, still and moving pictures) are transmitted from one port (terminal) in the exchange (switch) over one access line to and from the subscriber;

"interconnected radar sensors" means two or more radar sensors which mutually exchange data in real time;

an "intrinsic magnetic gradiometer" is a single magnetic field gradient sensing element and associated electronics, the output of which is a measure of magnetic field gradient;

"ISO" means the International Organization for Standardization;

"isostatic presses" means equipment capable of pressurising a closed cavity through various media (including gas, liquid and solid particles) to create equal pressure in all directions within the cavity upon a workpiece or material;

a "laser" is an assembly of components which produce both spatially and temporally coherent light which is amplified by stimulated emission of radiation;

"linearity" (usually measured in terms of non—linearity) means the maximum deviation of the actual characteristic (average of upscale and downscale readings), positive or negative, from a straight line so positioned as to equalise and minimise the maximum deviations;

a "local area network" is a data communication system which:

(a) allows any number of independent data devices to communicate directly with each other; and

(b) is confined to a geographical area of moderate size (e.g., office building, plant, campus, warehouse);

"magnetic gradiometers" are instruments designed to detect the spatial variation of magnetic fields from external sources; they consist of multiple magnetometers and associated electronics, the output of which is a measure of magnetic field gradient;

"magnetometers" are instruments designed to detect magnetic fields from external sources; they consist of a single magnetic field sensing element and associated electronics, the output of which is a measure of the magnetic field;

"main storage" means the primary storage for data or instructions for rapid access by a central processing unit; it consists of the internal storage of a digital computer and any hierarchical extension thereto, such as cache storage or non—sequentially accessed extended storage;

a "matrix" means a substantially continuous phase that fills the space between particles, whiskers or fibres;

"maximum bit transfer rate" of a disk drive or solid state storage device means the number of data bits per second transferred between the drive or the device and its controller;

"mechanical alloying" means an alloying process resulting from the bonding, fracturing and rebonding of elemental and master alloy powders by mechanical impact; non—metallic particles may be incorporated in the alloy by addition of the appropriate powders;

"media access unit" means equipment which contains one or more communication interfaces (network access controller, communications channel controller, modem or computer bus) to connect terminal equipment to a network;

"melt extraction" means a process to solidify rapidly and extract a ribbon—like alloy product by the insertion of a short segment of a rotating chilled block into a bath of a molten metal alloy;

"melt spinnning" means a process to solidify rapidly a molten metal stream impinging upon a rotating chilled block, forming a flake, ribbon or rod—like product;

"microcomputer microcircuit" means a monolithic integrated circuit or multichip integrated circuit containing an arithmetic logic unit (ALU) capable of executing general purpose instructions from an internal storage (or on an internal storage augmented by an external storage), on data contained in the internal storage;

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

"missiles" means complete rocket systems and unmanned air vehicle systems, capable of a range of at least 300km;

"monolithic integrated circuit" means a combination of passive or active circuit elements or both which:

(a) are formed by means of diffusion processes, implantation processes or deposition processes in or on a single semiconducting piece of material;

(b) can be considered as indivisibly associated; and

(c) performs the function of a circuit;

"motion control board" means an electronic assembly specially designed to provide a computer system with the capability to coordinate simultaneously the motion of axes of machine tools for contouring control;

"multichip integrated circuit" means two or more monolithic integrated circuits bonded to a common substrate;

"multi—data—stream processing" means the microprogramme or equipment architecture technique which permits simultaneous processing of two or more data sequences under the control of one or more instruction sequences by means such as:

(a) Single Instruction Multiple Data (SIMD) architectures such as vector or array processors;

(b) Multiple Single Instruction Multiple Data (MSIMD) architectures;

(c) Multiple Instruction Multiple Data (MIMD) architectures, including those which are tightly coupled, closely coupled or loosely coupled; or

(d) Structured arrays of processing elements, including systolic arrays;

"multilevel security" means a class of system containing information with different sensitivities that simultaneously permits access by users with different security clearances, but prevents users from obtaining access to information for which they lack authorization;

"multispectral imaging sensors" are capable of simultaneous or serial acquisition of imaging data from two or more discrete spectral bands; sensors having more than twenty discrete spectral bands are sometimes referred to as hyperspectral imaging sensors;

"network access controller" means a physical interface to a distributed switching network which:

(a) uses a common medium operating throughout at the same digital transfer rate;

(b) uses arbitration (e.g., token or carrier sense) for transmission control;

(c) independently from any other, selects data packets or data groups addressed to it; and

(d) is an assembly that can be integrated into computer or telecommunications equipment to provide communications access;

"neural computer" means a computational device designed or modified to mimic the behaviour of a neuron or a collection of neurons, i.e., a computational device which is distinguished by its hardware capability to modulate the weights and numbers of the interconnections of a multiplicity of computational components based on previous data;

"noise level" means an electrical signal given in terms of power spectral density; the relation between noise level expressed in peak—to—peak is given by $S^2pp = 8\ N_0(f_2–f_1)$, where Spp is the peak—to—peak value of the signal (e.g., nanoteslas), N_0 is the power spectral density (e.g., $(\text{nanotesla})^2/\text{Hz}$) and $(f_2–f_1)$ defines the bandwidth of interest;

“numerical control” means the automatic control of a process performed by a device that makes use of numeric data usually introduced as the operation is in progress;

“object code” (sometimes referred to as object language) is an equipment executable form of a convenient expression of one or more processes (source code) which has been converted by a programming system;

“operate autonomously” means operating fully submerged, without snorkel, all systems working and cruising at the minimum speed at which the submersible can safely control its depth dynamically by using its depth planes only, with no need for a support vessel or support base on the surface, sea—bed or shore, and containing a propulsion system for submerged or surface use;

“optical amplification”, in optical communications, means an amplification technique that introduces a gain of optical signals that have been generated by a separate optical source, without conversion to electrical signals, using semiconductor optical amplifiers or optical fibre lumineeescent amplifiers;

“optical computer” means a computer designed or modified to use light to represent data and whose computational logic elements are based on directly coupled optical devices;

“optical fibre preforms” means bars, ingots, or rods of glass, plastic or other materials which have been specially processed for use in fabricating optical fibres; the characteristics of an optical fibre preform determine the basic parameters of the resultant drawn optical fibres;

“optical integrated circuit” means a monolithic integrated circuit or a hybrid integrated circuit, containing one or more parts designed to function as a photosensor or photoemitter or to perform an optical or an electro—optical function;

“optical switching” means the routing of, or switching of, signals in optical form without conversion to electrical signals;

“overall current density” means the total number of ampere—turns in the coil (i.e., the sum of the number of turns multiplied by the maximum current carried by each turn) divided by the total cross—section of the coil (comprising the superconducting filaments, the metallic matrix in which the superconducting filaments are embedded, the encapsulating material, any cooling channels, etc.);

“peak power”, as it relates to lasers, means energy per pulse in joules divided by the pulse duration in seconds;

“personalized smart card” means a smart card containing a microcircuit, in accordance with ISO/IEC 781, which has been programmed by the issuer and cannot be changed by the user;

“power management” means changing the transmitted power of the altimeter signal so that received power at the aircraft altitude is always at the minimum necessary to determine the altitude;

an element is a “principal element” when its replacement value is more than 35% of the total value of the system of which it is an element; element value is the cost of the element for the manufacturer of the system, or by the system integrator; total value is the normal international selling price to unrelated parties at the point of manufacture or consolidation of shipment;

“Private Automatic Branch Exchange” (PABX) means an automatic telephone exchange, (whether or not incorporating a position for an attendant), designed to provide access to the public network and serving extensions within an institution;

“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;

"pulse compression" means the coding and processing of a radar signal pulse of long time duration to one of short time duration, while maintaining the benefits of high pulse energy;

"pulse duration" is the duration of a laser pulse measured at Full Width Half Intensity (FWHI) levels;

"Q—switched laser" means a laser in which the energy is stored in the population inversion or in the optical resonator and subsequently emitted in a pulse;

"radar frequency agility" means any technique which changes, in a pseudo—random sequence, the carrier frequency of a pulsed radar transmitter between pulses or between groups of pulses by an amount equal to or larger than the pulse bandwidth;

"radar spread spectrum" means any modulation technique for spreading energy originating from a signal with a relatively narrow frequency band, over a much wider band of frequencies, by using random or pseudo—random coding;

"real time bandwidth" for dynamic signal analysers is the widest frequency range which the analyser can output to display or mass storage without causing any discontinuity in the analysis of the input data; for analysers with more than one channel, the channel configuration yielding the widest real—time bandwidth shall be used to make the calculation;

"real time processing" means processing of data by an electronic computer in response to an external event according to time requirements imposed by the external event;

"required", as applied to technology or software, refers to only that portion of technology or software which is peculiarly responsible for achieving or exceeding the specified performance levels, characteristics or functions; such required technology or software may be shared by different products;

"resolution" means the least increment of a measuring device; on digital instruments, the least significant bit;

"robot" means a manipulation mechanism, which may be of the continuous path or of the point-to-point variety, may use sensors, and which:

(a) is multifunctional;

(b) is capable of positioning or orienting material, parts, tools or special devices through variable movements in three dimensional space;

(c) incorporates three or more closed or open loop servo—devices which may include stepping motors; and

(d) has user—accessible programmability by means of the teach/playback method or by means of an electronic computer which may be a programmable logic controller, i.e., without mechanical intervention;

except:

(1) manipulation mechanisms which are only manually/teleoperator controllable;

(2) fixed sequence manipulation mechanisms, which are automated moving devices, operating according to programmes where the motions are limited by fixed stops, such as pins or cams and the sequence of motions and the selection of paths or angles are not variable or changeable by mechanical, electronic or electrical means;

(3) mechanically controlled variable sequence manipulation mechanisms, which are automated moving devices, operating according to programmes where the motions are limited by fixed, but adjustable stops, such as pins or cams and the sequence of motions and the selection of paths or angles are variable within the fixed programme pattern; variations or modifications of the programme pattern (e.g., changes of pins or exchanges of cams) in one or more motion axes are accomplished only through mechanical operations;

(4) non—servo—controlled variable sequence manipulation mechanisms, which are automated moving devices, operating according to mechanically fixed programmed motions; the programme is variable but the sequence proceeds only by the binary signal from mechanically fixed electrical binary devices or adjustable stops;

(5) stacker cranes defined as Cartesian coordinate manipulator systems manufactured as an integral part of a vertical array of storage bins and designed to access the contents of those bins for storage or retrieval;

"rotary atomisation" means a process to reduce a stream or pool of molten metal to droplets to a diameter of 500 micrometre or less by centrifugal force;

"run out" (out—of—true running) means radial displacement in one revolution of the main spindle measured in a plane perpendicular to the spindle axis at a point on the external or internal revolving surface to be tested;

"scale factor" means the ratio of change in output to a change in the input intended to be measured; scale factor is generally evaluated as the slope of the straight line that can be fitted by the method of least squares to input—output data obtained by varying the input cyclically over the input range;

"settling time" means the time required for the output to come within one—half bit of the final value when switching between any two levels of the converter;

"signal analysers" means apparatus capable of measuring and displaying basic properties of the single—frequency components of multi—frequency signals;

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

"simple educational devices" means devices designed for use in teaching basic scientific principles and demonstrating the operation of those principles in educational institutions;

"solidify rapidly" means solidification of molten material at cooling rates exceeding1,000 K/ sec;

"source code" (sometimes referred to as source language) is a convenient expression of one or more processes which may be turned by a programming system into equipment executable form (object code);

"spacecraft" means active and passive satellites and space probes;

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

"specific modulus" is Young's modulus in pascals, equivalent to N/m^2 divided by specific weight in N/m^3, measured at a temperature of (296±2) K ((23±2)°C) and a relative humidity of (50±5)%;

"specific tensile strength" is ultimate tensile strength in pascals, equivalent to N/m^2 divided by specific weight in N/m^3, measured at a temperature of (296±2) K ((23±2)°C) and a relative humidity of (50±5)%;

"spectral efficiency" is a figure of merit which characterizes the efficiency of transmission systems which use complex modulation schemes including QAM (quadrature amplitude modulation), Trellis coding and QPSK (Q—phased shift key); it is calculated as follows:

$$\text{spectral efficiency} = \frac{\textbf{digital transfer rate (bits/second)}}{\text{6 dB spectrum bandwidth (Hz)}}$$

"splat quenching" means a process to solidify rapidly a molten metal stream impinging upon a chilled block, forming a flake—like product;

"spread spectrum" means the technique whereby energy in a relatively narrow—band communication channel is spread over a much wider energy spectrum;

"sputtering" means an overlay coating process wherein positively charged ions areaccelerated by an electric field towards the surface of a target (coating material); the kinetic energy of the impacting ions is sufficient to cause target surface atoms to be released and deposited on the substrate; triode, magnetron or radio frequency sputtering to increase adhesion of coating and rate of deposition are ordinary modifications of the process;

"stability" means 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;

"stored programme controlled" means controlled by using instructions stored in an electronic storage which a processor can execute in order to direct the performance of predetermined functions;

"substrate" means a sheet of base material with or without an interconnection pattern and on which or within which discrete components or integrated circuits or both can be located;

"substrate blanks" means monolithic compounds with dimensions suitable for the production of optical elements such as mirrors or optical windows;

"superalloys" means nickel—, cobalt— or iron—base alloys having strengths superior to any alloys in the American Iron and Steel Society (AISI) 300 series at temperatures over 922 K (649°C) under severe environmental and operating conditions;

"superconductive" refers to materials (i.e., metals, alloys or compounds) which can lose all electrical resistance (i.e., which can attain infinite electrical conductivity and carry very large electrical currents without Joule heating); the superconductive state of a material is individually characterised by a critical temperature, a critical magnetic field, which is a function of temperature, and a critical current density which is a function of both magnetic field and temperature;

"Super High Power Laser" (SHPL) means a laser capable of delivering (the total or any portion of) an output energy exceeding 1 kJ within 50 ms or having an average or CW power exceeding 20 kW;

"superplastic forming" means a deformation process using heat for metals that are normally characterised by low values of elongation (less than 20%) at the breaking point as determined at room temperature by conventional tensile strength—testing, in order to achieve elongations during processing which are at least 2 times those values;

"swept frequency network analysers" means analysers which involve the automatic measurement of equivalent circuit parameters over a range of frequencies, involving swept frequency measurement techniques but not continuous wave point—to—point measurements;

"switch fabric" means that hardware and associated software which provides the physical or virtual connection path for in—transit message traffic being switched;

"Synchronous Digital Hierarchy" (SDH) means a digital hierarchy providing a means to manage, multiplex and access various forms of digital traffic using a synchronous transmission format on different types of media; the format is based on the Synchronous Transport Module (STM) which is defined by CCITT Recommendation G.703, G.707, G.708, G.709; the first level rate of SDH is 155·52 Mbit/s;

"Synchronous Optical Network" (SONET) means a network providing a means to manage, multiplex and access various forms of digital traffic using a synchronous transmission format on fibre optics; the format is the North America version of SDH and also uses the Synchronous

Transport Module (STM); however, it uses the Synchronous Transport Signal (STS) as the basic transport module with a first level rate of 51·81 Mbit/s; the SONET standards are being integrated into those of SDH;

"systems tracks" means processed, correlated (fusion of radar target data to flight plan position) and updated aircraft flight position reports available to the Air Traffic Control centre controllers;

"systloic array computer" means a computer where the flow and modification of the data is dynamically controllable at the logic gate level by the user;

"terminal interface equipment" means equipment at which information enters or leaves the telecommunication system, including telephone, data device, computer and facsimile device;

"tilting spindle" means a tool—holding spindle which alters, during the machining process, the angular position of its centre line with respect to any other axis;

"time constant" is the time taken from the application of a light stimulus for the current increment to reach a value of 1—1/e times the final value (i.e., 63% of the final value);

"total digital transfer rate" means the number of bits, including line coding, overhead and so forth per unit time passing between corresponding equipment in a digital transmission system;

"transfer laser" means a laser in which the lasing species is excited through the transfer of energy by collision of a non—lasing atom or molecule with a lasing atom or molecule species;

"tunable" refers to the ability of a laser to produce a continuous output at all wavelengths over a range of several laser transitions; a line selectable laser produces discrete wavelengths within one laser transition and is not considered tunable;

"user—accessible programmability" means the facility allowing a user to insert, modify or replace programmes by means other than:

(a) a physical change in wiring or interconnections; or

(b) the setting of function controls including entry of parameters;

"vacuum atomisation" means a process to reduce a molten stream of metal to droplets of a diameter of 500 micrometre or less by the rapid evolution of a dissolved gas upon exposure to a vacuum;

"variable geometry airfoils" means the use of trailing edge flaps or tabs, or leading edge slats or pivoted nose droop, the position of which can be controlled in flight.

Category 1Materials, Chemicals, Microorganisms and Toxins

Equipment, Assemblies and Components

1A

1A001

Components made from fluorinated compounds, as follows:

(a) Seals, gaskets, sealants or fuel bladders specially designed for aircraft or aerospace use made from more than 50% of any of the materials specified in heads b. or c. of entry 1C009;

(b) Piezoelectric polymers and copolymers made from vinylidene fluoride:

1. In sheet or film form; and

2. With a thickness exceeding 200 micrometre;

(c) Seals, gaskets, valve seats, bladders or diaphragms made from fluoroelastomers containing at least one vinylether monomer, specially designed for aircraft, aerospace or `missile' use. In this entry, `missile' means complete rocket systems and unmanned air vehicle systems.

1A002

Composite structures or laminates, as follows(**4**):

(a) Having an organic matrix and made from materials specified in heads c., d. or e. of entry 1C010; or

(b) Having a metal or carbon matrix and made from:

1. Carbon fibrous or filamentary materials with:

(a) A specific modulus exceeding $10{\cdot}15 \times 10^6$ m; and

(b) A specific tensile strength exceeding $17{\cdot}7 \times 10^4$ m; or

1. Materials specified in head c. of entry 1C010.

Note: This entry does not specify composite structures or laminates made from epoxy resin impregnated carbon fibrous or filamentary materials for the repair of aircraft structures or laminates, provided the size does not exceed $1m^2$.

1A003

Manufactures of non—fluorinated polymeric substances specified in head a. of entry 1C008, in film, sheet, tape or ribbon form:

(a) With a thickness exceeding 0·254mm; or

(b) Coated or laminated with carbon, graphite, metals or magnetic substances.

1A102

Resaturated pyrolized carbon—carbon materials designed for systems specified in entries 9A004 or 9A104.

1A202

Composite structures, other than those specified in entry 1A002, in the form of tubes with an inside diameter of between 75mm and 400mm made with fibrous or filamentary materials specified in heads a. or b. of entry 1C010 or entry 1C210(**5**).

1A225

Platinized catalysts specially designed or prepared for promoting the hydrogen isotope exchange reaction between hydrogen and water for the recovery of tritium from heavy water or for the production of heavy water.

1A226

Specialized packings for use in separating heavy water from ordinary water and made of phosphor bronze mesh or copper (both chemically treated to improve wettability) and designed for use in vacuum distillation towers.

(**4**) See also entries 1A202, 9A010 and 9A110.
(**5**) See also entry 9A110.

1A227

High—density (lead glass or other) radiation shielding windows greater than 0·3m on a side and with a density greater than 3g/cm^3 and a thickness of 100mm or greater and specially designed frames therefor.

Test, Inspection and Production Equipment

1B

1B001

Equipment for the production of fibres, prepregs, preforms or composites specified in entries 1A002 or 1C010, as follows, and specially designed components and accessories therefor(**6**):

(a) Filament winding machines of which the motions for positioning, wrapping and winding fibres are coordinated and programmed in three or more axes, specially designed for the manufacture of composite structures or laminates from fibrous or filamentary materials;

(b) Tape—laying or tow—placement machines of which the motions for positioning and laying tape, tows or sheets are coordinated and programmed in two or more axes, specially designed for the manufacture of composite airframe or `missile' structures;

In this entry, `missile' means complete rocket systems and unmanned air vehicle systems.

(c) Multidirectional, multidimensional weaving machines or interlacing machines, including adapters and modification kits, for weaving, interlacing or braiding fibres to manufacture composite structures;

except:

Textile machinery not modified for the above end—uses;

(d) Equipment specially designed or adapted for the production of reinforcement fibres, as follows:

1. Equipment for converting polymeric fibres (such as polyacrylonitrile, rayon, pitch or polycarbosilane) into carbon fibres or silicon carbide fibres, including special equipment to strain the fibre during heating;
2. Equipment for the chemical vapour deposition of elements or compounds on heated filamentary substrates to manufacture silicon carbide fibres;
3. Equipment for the wet—spinning of refractory ceramics (such as aluminium oxide);
4. Equipment for converting aluminium containing precursor fibres into alumina fibres by heat treatment;

(e) Equipment for producing prepegs specified in head e. of entry 1C010 by the hot melt method;

(f) Non—destructive inspection equipment capable of inspecting defects three dimensionally, using ultrasonic or X—ray tomography and specially designed for composite materials.

1B002

Systems and components therefor specially designed for producing metal alloys, metal alloy powder or alloyed materials specified in sub—head a.2. of entry 1C002, head b. of entry 1C002 or head c. of entry 1C002.

(**6**) See also entries 1B101, 1B201.

1B003

Tools, dies, moulds or fixtures, for superplastic forming or diffusion bonding titanium or aluminium or their alloys, specially designed for the manufacture of:

(a) Airframe or aerospace structures;

(b) Aircraft or aerospace engines; or

(c) Specially designed components for those structures or engines.

1B101

Equipment, other than that specified in entry 1B001, for the production of structural composites as follows; and specially designed components and accessories therefor(**7**):

Note: Components and accessories specified in this entry include moulds, mandrels, dies, fixtures and tooling for the preform pressing, curing, casting, sintering or bonding of composite structures, laminates and manufactures thereof.

(a) Filament winding machines of which the motions for positioning, wrapping and winding fibres are coordinated and programmed in three or more axes, designed to fabricate composite structures or laminates from fibrous and filamentary materials, and coordinating and programming controls;

(b) Tape—laying machines of which the motions for positioning and laying tape and sheets are coordinated and programmed in two or more axes, designed for the manufacture of composite airframe and missile structures;

(c) Interlacing machines, including adapters and modification kits for weaving, interlacing or braiding fibres designed to fabricate composite structures;

except:

Textile machinery which has not been modified for the above end uses;

(d) Equipment designed or modified for the production of fibrous and 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; and

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 specified in entry 9A110.

Note: Equipment covered by this sub—head includes rollers, tension stretchers, coating equipment, cutting equipment and clicker dies.

1B115

Equipment for the production, handling and acceptance testing of goods specified in entry 1C115, and specially designed components therefor.

Note: The only mixers specified in this entry are those which have provision for mixing under vacuum in the range of zero to 13·326kPa and with temperature control capability of the mixing chamber:

(**7**) See also entry 1B201.

(a) Batch mixers having a total volumetric capacity of 110 litres or more and at least one mixing/kneading shaft mounted off centre;

(b) Continuous mixers having two or more mixing/kneading shafts and capability to open the mixing chamber.

1B116

Specially designed nozzles for producing pyrolitically derived materials formed on a mould, mandrel or other substrate from precursor gases which decompose in the 1573K (1300°C) to 3173K (2900°C) temperature range at pressures of 130Pa to 20kPa.

1B201

Filament winding machines, other than those specified in entries 1B001 or 1B101, in which the motions for positioning, wrapping, and winding fibres are coordinated and programmed in two or more axes, specially designed to fabricate composite structures or laminates from fibrous or filamentary materials and capable of winding cylindrical rotors of diameter between 75mm and 400mm and lengths of 600mm or greater andcoordinating and programming controls and precision mandrels therefor.

1B225

Electrolytic cells for fluorine production with a production capacity greater than 250g of fluorine per hour.

1B226

Electromagnetic isotope separators, designed for or equipped with, single or multiple ion sources capable of providing a total ion beam current of 50mA or greater.

Notes:

(1) This entry includes separators capable of enriching stable isotopes.

(2) This entry includes separators with the ion sources and collectors both in the magnetic field and those configurations in which they are external to the field.

1B227

Ammonia synthesis converters, ammonia synthesis units in which the synthesis gas (nitrogen and hydrogen) is withdrawn from an ammonia/hydrogen high—pressure exchange column and the synthesized ammonia is returned to said column.

1B228

Hydrogen—cryogenic distillation columns having all of the following characteristics:

(a) Designed to operate with internal temperatures of 35 K (−238°C) or less;

(b) Designated to operate at an internal pressure of 0·5 to 5 MPa (5 to 50 atmospheres);

(c) Constructed of fine—grain stainless steels of the 300 series with low sulphur content or equivalent cryogenic and H_2—compatible materials; and

(d) With internal diameters of 1 m or greater and effective lengths of 5 m or greater.

1B229

Water—hydrogen sulphide exchange tray columns constructed from fine carbon steel with a diameter of 1·8m or greater to operate at a nominal pressure of 2 MPa or greater.

Notes:

(1) For columns which are specially designed or prepared for the production of heavy water see entry B40 of Group 2 of Part III of this Schedule.

(2) This entry includes internal contactors of the columns, which are segmented trays with an effective assembled diameter of 1\8m or greater, such as sieve trays, valve trays, bubble cap trays, and turbogrid trays designed to facilitate countercurrent contacting and constructed of materials resistant to corrosion by hydrogen sulphide/water mixtures, such as 304L or 316 stainless steel.

(3) Fine Carbon steels include steels such as specified by ASTM A516.

1B230

Pumps circulating solutions of diluted or concentrated potassium amide catalyst in liquid ammonia (KNH_2/NH_3), with all of the following characteristics:

(a) Airtight (i.e., hermetically sealed);

(b) For concentrated potassium amide solutions (1% or greater), operating pressure of 1·5–60 MPa (15–600 atmospheres); for dilute potassium amide solutions (less than 1%), operating pressure of 20–60 MPa (200–600 atmospheres); and

(c) A capacity greater than 8·5 m^3/hr.

1B231

Facilities or plants for the production, recovery, extraction, concentration, or handling of tritium, and equipment as follows:

(a) Hydrogen or helium refrigeration units capable of cooling to 23 K (−250°C) or less, with heat removal capacity greater than 150 watts; or

(b) Hydrogen isotope storage and purification systems using metal hydrides as the storage, or purification medium.

Materials

1C

1C001

Materials specially designed for use as absorbers of electromagnetic waves, or intrinsically conductive polymers, as follows(**8**):

(a) Materials for absorbing frequencies exceeding 2×10^8 Hz but less than 3×10^{12} Hz;

except:

Materials as follows:

Note: Nothing in head a. of this entry releases magnetic materials to provide absorption when contained in paint.

(1) Hair type absorbers, constructed of natural or synthetic fibres, with non—magnetic loading to provide absorption;

(**8**) See also entry 1C101.

(2) Absorbers having no magnetic loss and whose incident surface is non—planar in shape, including pyramids, cones, wedges and convoluted surfaces;

(3) Planar absorbers:

(a) Made from:

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

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

Technical Note: Absorption test samples for sub—head a.3.a. of this entry should be a square at least 5 wavelengths of the centre frequency on a side and positioned in the far field of the radiating element.

(b) Tensile strength less than 7×10^6 N/m^2; and

(c) Compressive strength less than 14×10^6 N/m^2;

(4) Planar absorbers made of sintered ferrite, with:

(a) A specific gravity exceeding 4·4; and

(b) A maximum operating temperature of 548 K (275°C);

(b) Materials for absorbing frequencies exceeding $1{\cdot}5\times10^{14}$ Hz but less than $3{\cdot}7\times10^{14}$ Hz and not transparent to visible light;

(c) Intrinsically conductive polymeric materials with a bulk electrical conductivity exceeding 10,000 S/m (Siemens per metre) or a sheet (surface) resistivity of less than 100 ohms/square, based on any of the following polymers:

(1) Polyaniline;

(2) Polypyrrole;

(3) Polythiophene;

(4) Polyphenylene—vinylene; or

(5) Polythienylene—vinylene.

Technical Note: Bulk electrical conductivity and sheet (surface) resistivity should be determined using ASTM D—257.

1C002

Metal alloys, metal alloy powder or alloyed materials, as follows(**9**):

Note: Entry 1C002 does not specify metal alloys, metal alloy powder or alloyed materials for coating substrates.

(a) Metal alloys, as follows:

1. Nickel or titanium—based alloys in the form of aluminides, as follows, in crude or semi—fabricated forms:

a. Nickel aluminides containing 10 weight % or more aluminium;

b. Titanium aluminides containing 12 weight % or more aluminium;

(**9**) See also entry 1C202.

(2) Metal alloys, as follows, made from metal alloy powder or particulate material specified in head b. of this entry:

(a) Nickel alloys with:

(1) A stress—rupture life of 10,000 hours or longer at 923 K (650°C) at a stress of 550 MPa; or

(2) A low cycle fatigue life of 10,000 cycles or more at 823 K (550°C) at a maximum stress of 700 MPa;

(b) Niobium alloys with:

(1) A stress—rupture life of 10,000 hours or longer at 1,073 K (800°C) at a stress of 400 MPa; or

(2) A low cycle fatigue life of 10,000 cycles or more at 973 K (700°C) at a maximum stress of 700 MPa;

(c) Titanium alloys with:

(1) A stress—rupture life of 10,000 hours or longer at 723 K (450°C) at a stress of 200 MPa; or

(2) A low cycle fatigue life of 10,000 cycles or more at 723 K (450°C) at a maximum stress of 400 MPa;

(d) Aluminium alloys with a tensile strength of:

(1) 240 MPa or more at 473 K (200°C); or

(2) 415 MPa or more at 298 K (25°C);

(e) Magnesium alloys with a tensile strength of 345 MPa or more and a corrosion rate of less than 1 mm/year in 3% sodium chloride aqueous solution measured in accordance with ASTM standard G—31;

Technical Notes:

1. The metal alloys specified in head a. of this entry are those containing a higher percentage by weight of the stated metal than of any other element.

2. Stress—rupture life should be measured in accordance with ASTM standardE—139.

3. Low cycle fatigue life should be measured in accordance with ASTM Standard E—606 `Recommended Practice for Constant—Amplitude Low—Cycle Fatigue Testing'. Testing should be axial with an average stress ratio equal to 1 and a stress—concentration factor (Kt) equal to 1. The average stress is defined as maximum stress minus minimum stress divided by maximum stress.

(b) Metal alloy powder or particulate material for materials specified in head a. of this entry, as follows:

(1) Made from any of the following composition systems:

Technical Note: X in the following equals one or more alloying elements.

(a) Nickel alloys (Ni—Al—X, Ni—X—Al) qualified for turbine engine parts or components, i.e., with less than 3 non—metallic particles (introduced during the manufacturing process) larger than 100 micrometre in 10^9 alloy particles;

(b) Niobium alloys (Nb—Al—X or Nb—X—Al, Nb—Si—X or Nb—X—Si, Nb—Ti—X or Nb—X—Ti);

(c) Titanium alloys (Ti—Al—X or Ti—X—Al);

(d) Aluminium alloys (Al—Mg—X or Al—X—Mg, Al—Zn—X or Al—X—Zn, Al—Fe—X or Al—X—Fe); or

(e) Magnesium alloys (Mg—Al—X or Mg—X—Al); and

(2) Made in a controlled environment by any of the following processes:

(a) Vacuum atomisation;

(b) Gas atomisation;

(c) Rotary atomisation;

(d) Splat quenching;

(e) Melt spinning and comminution;

(e) Melt extraction and comminution; or

(g) Mechanical alloying;

(c) Alloyed materials, in the form of uncomminuted flakes, ribbons or thin rods produced in a controlled environment by splat quenching, melt spinning or melt extraction, used in the manufacture of metal alloy powder or particulate material specified in head b. of this entry.

1C003

Magnetic metals, of all types and of whatever form, having any of the following characteristics:

(a) Initial relative permeability of 120,000 or more and a thickness of 0·05 mm or less;

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

(b) Magnetostrictive alloys with:

1. A saturation magnetostriction of more than 5×10^{-4}; or
2. A magnetomechanical coupling factor k. of more than 0·8; or

(c) Amorphous alloy strips having both of the following characteristics:

1. A composition having a minimum of 75 weight % of iron, cobalt or nickel; and
2. A saturation magnetic induction (Bs) of 1·6 T or more, and:

a. A strip thickness of 0·02 mm or less; or

b. An electrical resistivity of 2×10^{-4} ohm cm or more.

1C004

Uranium titanium alloys or tungsten alloys with a matrix based on iron, nickel or copper, with:

(a) A density exceeding 17·5 g/cm^3;

(b) An elastic limit exceeding 1,250 MPa;

(c) An ultimate tensile strength exceeding 1,270 MPa; and

(d) An elongation exceeding 8%.

1C005

Superconductive composite conductors in lengths exceeding 100m or with a mass exceeding 100g, as follows:

(a) Multifilamentary superconductive composite conductors containing one or more niobium —titanium filaments:

1. Embedded in a matrix other than a copper or copper—based mixed matrix; or

2. With a cross—section area less than $0{\cdot}28\times10^{-4}$ mm^2 (6 micrometre in diameter for circular filaments);

(b) Superconductive composite conductors consisting of one or more superconductive filaments other than niobium—titanium:

1. With a critical temperature at zero magnetic induction exceeding 9·85K (−263·31°C) but less than 24K (−249·16°C);

2. With a cross—section area less than $0{\cdot}28\times10^{-4}$ mm^2; and

3. Which remain in the superconductive state at a temperature of 4·2K (−268·96°C) when exposed to a magnetic field corresponding to a magnetic induction of 12T.

1C006

Fluids and lubricating materials, as follows:

(a) Hydraulic fluids containing, as their principal ingredients, any of the following compounds or materials:

1. Synthetic hydrocarbon oils or silahydrocarbon oils with:

a. A flash point exceeding 477K (204°C);

b. A pour point at 239K (−34°C) or less;

c. A viscosity index of 75 or more; and

d. A thermal stability at 616K (343°C); or

Note: For the purpose of this sub—head, silahydrocarbon oils contain exclusively silicon, hydrogen and carbon.

(2) Chlorofluorocarbons with:

(a) No flash point;

(b) An autogenous ignition temperature exceeding 977K (704°C);

(c) A pour point at 219K (−54°C) or less;

(d) A viscosity index of 80 or more; and

(e) A boiling point at 473K (200°C) or higher;

Note: For the purpose of this sub—head, chlorofluorocarbons contain exclusively carbon, fluorine and chlorine.

(b) Lubricating materials containing, as their principal ingredients, any of the following compounds or materials:

1. Phenylene or alkylphenylene ethers or thio—ethers, or their mixtures, containing more than two ether or thio—ether functions or mixtures thereof; or

2. Fluorinated silicone fluids with a kinematic viscosity of less than 5,000mm^2/s (5,000 centistokes) measured at 298K (25°C);

(c) Damping or flotation fluids with a purity exceeding 99·8%, containing less than 25 particles of 200 micrometre or larger in size per 100ml and made from at least 85% of any of the following compounds or materials:

1. Dibromotetrafluoroethane;

2. Polychlorotrifluoroethylene (oily and waxy modifications only); or

3. Polybromotrifluoroethylene.

Technical Note:

For the purpose of this entry:

(a) Flash point is determined using the Cleveland Open Cup Method described in ASTM D —92;

(b) Pour point is determined using the method described in ASTM D—97;

(c) Viscosity index is determined using the method described in ASTMD—2270;

(d) Thermal stability is determined by the following test procedure:

Twenty ml of the fluid under test is placed in a 46ml type 317 stainless steel chamber containing one each of 12·5mm (nominal) diameter balls ofM—10 tool steel, 52100 steel and naval bronze (60% Cu, 39% Zn, 0·75% Sn). The chamber is purged with nitrogen, sealed at atmospheric pressureand the temperature raised to and maintained at 644±6K (371±6°C) forsix hours. The specimen will be considered thermally stable if, on completion of the above procedure, all of the following conditions are met:

1. The loss in weight of each ball is less than 10mg/mm^2 of ball surface;
2. The change in original viscosity as determined at 311K (38°C) is less than 25%; and
3. The total acid or base number is less than 0·40;

(e) Autogenous ignition temperature is determined using the method described in ASTM E —659.

1C007

Ceramic base materials, non—composite ceramic materials, ceramic—matrix composite materials and precursor materials, as follows(**10**):

(a) Base materials of single or complex borides of titanium having total metallic impurities, excluding intentional additions, of less than 5,000ppm, an average particle size equal to or less than 5 micrometre and no more than 10% of the particles larger than 10 micrometre;

(b) Non—composite ceramic materials in crude or semi—fabricated form, except abrasives, composed of borides of titanium with a density of 98% or more of the theoretical density;

(c) Ceramic—ceramic composite materials with a glass or oxide—matrix and reinforced with fibres from any of the following systems:

1. Si—N;
2. Si—C;
3. Si—Al—O—N; or
4. Si—O—N;

(d) Ceramic—ceramic composite materials, with or without a continuous metallic phase, containing finely dispersed particles or phases of any fibrous or whisker—like material, where carbides or nitrides of silicon, zirconium or boron form the matrix;

(e) Precursor materials (i.e., special purpose polymeric or metallo—organic materials) for producing any phase or phases of the materials specified in head c. of this entry, as follows:

1. Polydiorganosilanes (for producing silicon carbide);
2. Polysilazanes (for producing silicon nitride);
3. Polycarbosilazanes (for producing ceramics with silicon, carbon and nitrogen components).

(**10**) See also entry 1C107.

1C008

Non—fluorinated polymeric substances, as follows:

(a) 1. Bismaleimides;

2. Aromatic polyamide—imides;

3. Aromatic polyimides;

4. Aromatic polyetherimides having a glass transition temperature (Tg) exceeding 503K (230°C) as measured by the wet method;

Note: This head does not specify non—fusible compression moulding powders or moulded forms.

(b) Thermoplastic liquid crystal copolymers having a heat distortion temperature exceeding 523K (250°C) measured according to ASTM D—648, method A, with a load of 1·82N/mm^2 and composed of:

1. Either of the following:

a. Phenylene, biphenylene or naphthalene; or

b. Methyl, tertiary—butyl or phenyl substituted phenylene, biphenylene or naphthalene; and

2. Any of the following acids:

a. Terephthalic acid;

b. 6—hydroxy—2 naphthoic acid; or

c. 4—hydroxybenzoic acid;

(c) Polyarylene ether ketones, as follows:

1. Polyether ether ketone (PEEK);

2. Polyether ketone ketone (PEKK);

3. Polyether ketone (PEK);

4. Polyether ketone ether ketone ketone (PEKEKK);

(d) Polyarylene ketones;

(e) Polyarylene sulphides, where the arylene group is biphenylene, triphenylene or combinations thereof;

(f) Polybiphenylenethersulphone.

1C009

Unprocessed fluorinated compounds, as follows:

(a) Copolymers of vinylidene fluoride having 75% or more beta crystalline structure without stretching;

(b) Fluorinated polyimides containing 30% or more of combined fluorine;

(c) Fluorinated phosphazene elastomers containing 30% or more of combined fluorine.

1C010

Fibrous or filamentary materials which may be used in organic matrix, metallic matrix or carbon matrix composite structures or laminates, as follows(**11**):

(a) Organic fibrous or filamentary materials (except polyethylene) with:

(**11**) See also entry 1C210.

1. A specific modulus exceeding $12{\cdot}7\times10^6$ m; and
2. A specific tensile strength exceeding $23{\cdot}5\times10^4$ m;

(b) Carbon fibrous or filamentary materials with:

1. A specific modulus exceeding $12{\cdot}7\times10^6$ m; and
2. A specific tensile strength exceeding $23{\cdot}5\times10^4$ m;

Technical Note: Properties for materials described in this head should be determined using Suppliers of Advance Composite Materials Association (SACMA) recommended methods SRM 12 to 17 or Japanese Industrial Standard JIS—R—7601, Paragraph 6.6.2., and based on lot average.

Note: This head does not specify fabric made from fibrous or filamentary materials for the repair of aircraft structures or laminates in which the size of individual sheets does not exceed 50cm×90cm.

(c) Inorganic fibrous or filamentary materials with:

1. A specific modulus exceeding $2{\cdot}54\times10^6$ m; and
2. A melting, decomposition or sublimation point exceeding 1,922K (1,649°C) in an inert environment;

Note: This head does not specify:

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

(d) Fibrous or filamentary materials:

1. Composed of any of the following:
   a. Polyetherimides specified in head a. of entry 1C008; or
   b. Materials specified in heads b., c., d., e. or f. of entry 1C008; or
2. Composed of materials specified in sub—head d.1. of this entry and commingled with other fibres specified in heads a., b. or c. of this entry;

(e) Resin— or pitch—impregnated fibres (prepregs), metal or carbon—coated fibres (preforms) or carbon fibre preforms, as follows:

1. Made from fibrous or filamentary materials specified in heads a., b. or c. of this entry;
2. Made from organic or carbon fibrous or filamentary materials:
   a. With a specific tensile strength exceeding $17{\cdot}7\times10^4$ m;
   b. With a specific modulus exceeding $10{\cdot}15\times10^6$ m;
   c. Not specified in heads a. or b. of this entry; and

(d) When impregnated with materials specified in entry 1C008 or head b. of entry 1C009, or with phenolic or epoxy resins, having a glass transition temperature (Tg) exceeding 383K (110°C).

Note: This head does not specify epoxy resin matrix impregnated carbon fibrous or filamentary materials (prepregs) for the repair of aircraft structures or laminates, in which the size of individual sheets of prepreg does not exceed 50cm × 90cm.

1C101

Materials and devices for reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures (i.e., stealth technology), other than those specified in entry 1C001, usable in missiles and their subsystems.

Notes:

1. This entry includes:

(a) Structural materials and coatings specially designed for reduced radar reflectivity;

(b) Coatings, including paints, specially designed for reduced or tailored reflectivity or emissivity in the microwave, infrared or ultraviolet regions of the electromagnetic spectrum.

2. This entry does not include coatings when specially used for the thermal control of satellites.

1C107

Graphite and ceramic materials, as follows:

(a) Fine grain recrystallised bulk graphites, having a bulk density of 1·72g/cm^3 or greater, measured at 288K (15°C), pyrolytic or fibrous reinforced graphites, usable for rocket nozzles and reentry vehicle nose tips;

(b) Ceramic composite materials (dielectric constant less than 6 at frequencies from 100Hz to 10,000MHz), usable for radomes, and bulk machinable silicon—carbide reinforced unfired ceramic, usable for nose tips.

1C115

Propellants and constituent chemicals for propellants, as follows:

(a) Propulsive substances:

1. Spherical aluminium powder, other than that specified in ML8 of Group 1 of Part III of this Schedule, with particles of uniform diameter of less than500 micrometre and an aluminium content of 97% or greater;
2. Metal fuels, other than that specified in ML8 of Group 1 of Part III of this Schedule, in particle sizes less than 500 micrometres, whether spherical, atomized, spheroidal, flaked or ground, consisting of 97% or more of any of the following:
    a. Zirconium;
    b. Beryllium;
    c. Boron;
    d. Magnesium;
    e. Zinc;
    f. Alloys of the metals specified by a. to e. above; or
    g. Misch metal;
3. Liquid oxidisers, the following:
    a. Dinitrogen trioxide;
    b. Nitrogen dioxide/dinitrogen tetroxide;
    c. Dinitrogen pentoxide;

(b) Polymeric substances:

1. Carboxy—terminated polybutadiene (CTPB);
2. Hydroxy—terminated polybutadiene (HTPB), other than that specified in ML8 of Group 1 of Part III of this Schedule;
3. Polybutadiene—acrylic acid (PBAA);
4. Polybutadiene—acrylic acid—acrylonitrile (PBAN);

(c) Other propellant additives and agents:

1. Isophorone diisocyanate (IPDI);
2. Butacene;
3. Triethylene glycol dinitrate (TEGDN);
4. 2—Nitrodiphenylamine.

Note: For propellants and constituent chemicals for propellants not specified here, see ML8 of Group 1 of Part III of this Schedule.

1C116

Maraging steels (steels generally characterised by high nickel, very low carbon content and the use of substitutional elements to produce age—hardening) having an ultimate tensile strength of 1,500MPa or greater, measured at 293K (20°C), in the form of sheet, plate or tubing with a wall or plate thickness equal to or less than 5mm(**12**).

1C117

Tungsten, molybdenum and alloys of these metals in the form of uniform spherical or atomized particles of 500 micrometre diameter or less with a purity of 97% or greater for fabrication of rocket motor components i.e., heat shields, nozzle substrates, nozzle throats and thrust vector control surfaces.

1C202

Alloys, other than those specified in sub—head a.2.c. or head d. of entry 1C002, asfollows:

(a) Aluminium alloys capable of an ultimate tensile strength of 460MPa or more at 293K (20°C), in the form of tubes or solid forms (including forgings) with an outside diameter of more than 75mm;

(b) Titanium alloys capable of an ultimate tensile strength of 900MPa or more at 293K (20°C) in the form of tubes or solid forms (including forgings) with an outside diameter of more than 75mm.

Technical Note: For the purpose of this entry, the phrase `capable of' encompasses alloys before or after heat treatment.

1C210

Fibrous or filamentary materials, other than those specified in heads a. or b. of entry 1C010, as follows:

(a) Carbon or aramid fibrous or filamentary materials having a specific modulus of $12{\cdot}7\times10^6$ m or greater or a specific tensile strength of $23{\cdot}5\times10^4$ m or greater; or

(**12**) See also entry 1C216.

(b) Glass fibrous or filamentary materials having a specific modulus of $3{\cdot}18\times10^6$ m or greater and a specific tensile strength of $7{\cdot}62\times10^4$ m or greater.

1C216

Maraging steel, other than that specified in entry 1C116, capable of an ultimate tensile strength of 2,050MPa or more, at 293K (20°C);

except:

Forms in which no linear dimension exceeds 75mm.

Technical Note: For the purpose of this entry, the phrase `capable of' encompasses maraging steel before or after heat treatment.

1C225

Boron and boron compounds, mixtures and loaded materials in which the boron—10 isotope is more than 20% by weight of the total boron content.

1C226

Tungsten, as follows: parts made of tungsten, tungsten carbide, or tungsten alloys (greater than 90% tungsten) having a mass greater than 20kg and a hollow cylindrical symmetry (including cylinder segments) with an inside diameter greater than 100mm but less than 300mm;

except:

Parts specially designed for use as weights or gamma—ray collimators.

1C227

Calcium (high purity) containing both less than 1,000 parts per million by weight of metallic impurities other than magnesium and less than 10 parts per million of boron.

1C228

Magnesium (high purity) containing both less than 200 parts per million by weight of metallic impurities other than calcium and less than 10 parts per million of boron.

1C229

High purity (99·99% or greater) bismuth with very low silver content (less than 10 parts per million).

1C230

Beryllium metal, alloys containing more than 50% of beryllium by weight, compounds containing beryllium, and manufactures thereof;

except:

(a) Metal Windows for X—ray machines;

(b) Oxide shapes in fabricated or semi—fabricated forms specially designed for electronic component parts or as substrates for electronic circuits.

Note: This entry includes waste and scrap containing beryllium as defined here.

1C231

Hafnium metal, alloys and compounds of hafnium containing more than 60% hafnium by weight and manufactures thereof.

1C232

Helium in any form isotopically enriched in the helium—3 isotope, whether or not mixed with any other materials or contained in any equipment or device;

except:

Products or devices containing less than 1g of helium—3.

1C233

Lithium, as follows:

(a) Metal, hydrides or alloys containing lithium enriched in the 6 isotope (^{6}Li) to a concentration higher than the one existing in nature (7·5 weight %);

(b) Any other materials containing lithium enriched in the 6 isotope (including compounds, mixtures and concentrates);

except:

^{6}Li incorporated in thermoluminescent dosimeters.

1C234

Zirconium as follows: metal, alloys containing more than 50% zirconium by weight, and compounds in which the ratio of hafnium content to zirconium content is less than 1 part to 500 parts by weight, and manufactures wholly thereof;

except:

Zirconium in the form of foil having a thickness not exceeding 0·10mm.

Note: This entry includes waste and scrap containing zirconium as defined here.

1C235

Tritium, tritium compounds, and mixtures containing tritium in which the ratio of tritium to hydrogen by atoms exceeds 1 part in 1,000;

except:

A product or device containing not more than 40Ci of tritium in any chemical or physical form.

1C236

Alpha—emitting radionuclides having an alpha half—life of 10 days or greater but less than 200 years, including equipment, compounds and mixtures containing these radionuclides with a total alpha activity of 1 curie per kilogram (37GBq/kg) or greater;

except:

Devices containing less than 100 millicuries (3·7GBq) of alpha activity per device.

1C237

Radium—226;

except:

Radium contained in medical applicators.

1C238

Chlorine trifluoride ($C1F_3$).

1C239

High explosives(**13**), other than those specified in ML8 of Group 1 or Part III of this Schedule, or substances or mixtures containing more than 2% thereof, with a crystal density greater than 1·8gm per cm^3 and having a detonation velocity greater than 8,000m/s.

1C350

Chemicals, which may be used as precursors for toxic chemical agents, as follows, and preparations thereof(**14**):

(a) 1. Ammonium hydrogen fluoride;
2. Arsenic trichloride;
3. Benzilic acid;
4. 2—Chloroethanol;
5. Diethylaminoethanol;
6. Diethyl ethylphosphonate;
7. Diethyl methylphosphonite;
8. Diethyl—N,N—dimethylphosphoramidate;
9. Diethyl phosphite;
10. Diisopropylamine;
11. N,N—Diisopropyl—(beta)—aminoethane thiol;
12. N,N—Diisopropyl—(beta)—amino ethanol;
13. N,N—Diisopropyl—(beta)—aminoethyl chloride;
14. N,N—Diisopropyl—(beta)—aminoethyl chloride hydrochloride;
15. Dimethyl ethylphosphonate;
16. Dimethyl methylphosphonate;
17. Dimethyl phosphite;
18. Dimethylamine;
19. Dimethylamine hydrochloride;
20. Ethyl phosphinyl dichloride;
21. Ethyl phosphinyl difluoride;
22. Ethyl phosphonyl dichloride;
23. Ethyl phosphonyl difluoride;
24. Hydrogen fluoride;
25. 3—Hydroxy—1—methylpiperidine;

(**13**) See also entry 1C991.
(**14**) See also ML7 of group 1 of part III of this schedule.

26. Methyl benzilate;
27. Methyl phosphinyl dichloride;
28. Methyl phosphinyl difluoride;
29. Methyl phosphonyl dichloride;
30. Phosphorus oxychloride;
31. Phosphorus pentachloride;
32. Phosphorus pentasulphide;
33. Phosphorus trichloride;
34. Pinacolone;
35. Pinacolyl alcohol;
36. Potassium fluoride;
37. Potassium cyanide;
38. Potassium hydrogen fluoride;
39. 3—Quinuclidinol
40. 3—Quinuclidone;
41. Sodium bifluoride;
42. Sodium cyanide;
43. Sodium fluoride;
44. Sodium sulphide;
45. Sulphur dichloride;
46. Sulphur monochloride;
47. Thiodiglycol;
48. Thionyl chloride;
49. Triethanolamine;
50. Triethanolamine hydrochloride;
51. Triethyl phosphite;
52. Trimethyl phosphite;

except:

Preparations, including any of the above chemicals, which:

1. Are put up for retail sale and intended for individual personal use or consumption; or
2. Contain the chemical in such a way that it cannot be easily recovered by standard processes.

1C351

Human pathogens, zoonoses and toxins(**14**):

(a) Viruses, whether natural, enhanced or modified, either in the form of isolated live cultures or as material including living material which has been deliberately inoculated or contaminated with such cultures, as follows:

(**14**) See also ML7 of group 1 of part III of this schedule.

1. Chikungunya virus;
2. Congo—Crimean haemorrhagic fever virus;
3. Dengue fever virus;
4. Eastern equine encephalitis virus;
5. Ebola virus;
6. Hantaan virus;
7. Junin virus;
8. Lassa fever virus;
9. Lymphocytic choriomeningitis virus;
10. Machupo virus;
11. Marburg virus;
12. Monkey pox virus;
13. Rift Valley fever virus;
14. Russian Spring—Summer encephalitis virus;
15. Variola virus;
16. Venezuelan equine encephalitis virus;
17. Western equine encephalitis virus;
18. White pox;
19. Yellow fever virus;
20. Japanese encephalitis virus;

(b) Rickettsiae, whether natural, enhanced or modified, either in the form of isolated live cultures or as material including living material which has been deliberately inoculated or contaminated with such cultures, as follows:

1. Coxiella burnetii;
2. Rickettsia quintana;
3. Rickettsia prowasecki;
4. Rickettsia rickettsii;

(c) Bacteria, whether natural, enhanced or modified, either in the form of isolated live cultures or as material including living material which has been deliberately inoculated or contaminated with such cultures, as follows:

1. Bacillus anthracis;
2. Brucella abortus;
3. Brucella melitensis;
4. Brucella suis;
5. Chlamydia psittaci;
6. Clostridium botulinum;
7. Francisella tularensis;
8. Pseudomonas mallei;
9. Pseudomonas pseudomallei;
10. Salmonella typhi;

11. Shigella dysenteriae;
12. Vibrio cholerae;
13. Pasteurella pseudotuberculosis var pestis (Yersinia pestis);

(d) Toxins, as follows:

1. Botulinum toxins;
2. Clostridium perfringens toxins;
3. Conotoxin;
4. Ricin;
5. Saxitoxin;
6. Shiga toxin;
7. Staphylococcus aureus toxins;
8. Tetrodotoxin;
9. Verotoxin;
10. Microcystins (Cyanginosins).

1C352

Animal Pathogens, as follows(**15**):

(a) Viruses, whether natural, enhanced or modified, either in the form of isolated live cultures or as material including living material which has been deliberately inoculated or contaminated with such cultures, as follows:

1. African swine fever virus;
2. Avian influenza virus, which are:

(a) Uncharacterised; or

(b) Those defined in EC Directive 92/40/EC(**16**), as having high pathogenicity, as follows:

1. Type A viruses with an IVPI (intravenous pathogenicity index) in6 week old chickens of greater than 1·2; or
2. Type A viruses H5 or H7 subtype for which nucletide sequencing has demonstrated multiple basic amino acids at the cleavage site of haemagglutinin.
3. Bluetongue virus;
4. Foot and mouth disease virus;
5. Goat pox virus;
6. Porcine herpes virus (Aujeszky's disease);
7. Swine fever virus (Hog cholera virus);
8. Lyssa virus;
9. Newcastle disease virus;
10. Peste des petits ruminants virus;
11. Porcine enterovirus type 9;
12. Rinderpest virus;
13. Sheep pox virus;

(**15**) See also ML7 of group 1 of part III of this schedule.
(**16**) O.J. L.16 23.1.92 p.19.

14. Teschen disease virus;
15. Vesicular stomatitis virus;

(b) Bacteria, whether natural, enhanced or modified, either in the form of isolated live cultures or as material including living material which has been deliberately inoculated or contaminated with such cultures, as follows:

1. Mycoplasma mycoides.

1C353

Genetically—modified microorganisms, as follows(**17**):

(a) Genetically modified microorganisms or genetic elements that contain nucleic acid sequences associated with pathogenicity and are derived from organisms specified in heads a. to c. of entry 1C351 or heads a. or b. of entry 1C352;

(b) Genetically modified microorganisms or genetic elements that contain nucleic acid sequences coding for any of the toxins specified in head d. of entry 1C351.

1C990

Fluorine.

1C991

Other explosives and propellants and related substances as follows(**18**):

(a) Amatol;

(b) Hydrogen peroxide in concentrations of 85% or more;

(c) Nitrocellulose (containing more than 12·5% nitrogen);

(d) Nitroglycol;

(e) Pentaerythritol tetranitrate (PETN);

(e) Picryl chloride;

(g) Trinitrophenylmethylnitramine (tetryl);

(h) 2,4,6—Trinitrotoluene (TNT).

Software

1D

1D001

Software specially designed or modified for the development, production or use of goods specified in entries 1B001 to 1B003.

1D002

Software for the development of organic matrix, metal matrix or carbon matrix laminates or composites.

(**17**) See also ML7 of group 1 of part III of this schedule.
(**18**) See also entries 1C115, 1C239 or ML8 of group 1 of part III of this schedule.

1D101

Software specially designed for the use of goods specified in entry 1B101.

1D103

Software specially designed for analysis of reduced observables such as radar reflectivity, ultraviolet/infrared signatures and acoustic signatures.

1D201

Software specially designed for the use of goods specified in entry 1B201.

Technology

1E

1E001

Technology required for the development or production of goods specified in heads b. or c.of entry 1A001, or entries 1A002, 1A003, or sub—categories 1B or 1C.

1E002

The export of goods specified in this entry is only prohibited to any destination in any country listed in Schedule 2.

Other technology:

(a) Technology for the development or production of polybenzothiazoles or polybenzoxazoles;

(b) Technology for the development or production of fluoroelastomer compounds containing at least one vinylether monomer;

(c) Technology for the design or production of the following base materials or non—composite ceramic materials:

1. Base materials having all of the following characteristics:

(a) Any of the following compositions:

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

(b) Total metallic impurities, excluding intentional additions, of less than:

1. 1,000 ppm for single oxides or carbides; or
2. 5,000 ppm for complex compounds or single nitrides; and

(c) 1. Average particle size equal to or less than 5 micrometre and no more than 10% of the particles larger than 10 micrometre; or

Note: For zirconia, these limits are 1 micrometre and 5 micrometre respectively.

(2)

(a) Platelets with a length to thickness ratio exceeding 5;

(b) Whiskers with a length to diameter ratio exceeding 10 for diameters less than 2 micrometre; and

(c) Continuous or chopped fibres less than 10 micrometre in diameter;

1. Non—composite ceramic materials (except abrasives) composed of the materials described in sub—head c.1. of this entry;

(d) Technology for the production of aromatic polyamide fibres;

(e) Technology for the installation, maintenance or repair of materials specified in entry 1C001;

(f) Technology for the repair of composite structures, laminates or materials specified in entry 1A002 and heads c. or d. of entry 1C007.

Note:Head f. of this entry does not specify technology for the repair of civil aircraft structures using carbon fibrous or filamentary materials and epoxy resins, contained in manufacturers' manuals.

1E101

Technology required for the use of goods specified in entries 1A102, 1B001, 1B101, 1B115, 1B116, 1C001, 1C101, 1C107, 1C115 to 1C117, 1D101 or 1D103.

1E102

Technology required for the development of software specified in entries 1D001, 1D101 or 1D103.

1E103

Technology for the regulation of temperature, pressure or atmosphere in autoclaves or hydroclaves, when used for the production of composites or partially processed composites.

1E104

Technology relating to the production of pyrolitically derived materials formed on a mould, mandrel or other substrate from precursor gases which decompose in the 1,573 K (1,300°C) to 3,173 K (2,900°C) temperature range at pressures of 130 Pa to 20kPa.

Note: This entry includes technology for the composition of precursor gases,flow—rates and process control schedules and parameters.

1E201

Technology required for the use of goods specified in entries 1A002, 1A202, 1A225 to 1A227, 1B201, 1B225 to 1B231, sub—heads a.2.c. and a.2.d. of entry 1C002, head b. of entry 1C010, or entries 1C202, 1C210, 1C216, 1C225 to 1C239 or 1D201.

1E202

Technology required for the development or production of goods specified in entries 1A202, 1A225 to 1A227.

1E203

Technology required for the development of software specified in entry 1D201.
Category 2Materials Processing

Equipment, Assemblies and Components

2A Technical Notes to 2A001 to 2A006:

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

2. Operating temperatures include those temperatures obtained when a gas turbine engine has stopped after operation.

2A001

Ball bearings or solid roller bearings (except tapered roller bearings) having tolerances specified by the manufacturer in accordance with ISO Standard Class 4 (Annular Bearing Engineers Committee (ABEC) 7, ABEC 7P, ABEC 7T) or better, and having any of the following characteristics:

(a) Rings, balls or rollers made from monel or beryllium;

(b) Manufactured for use at operating temperatures above 573 K (300°C) either by using special materials or by special heat treatment; or

(c) With lubricating elements or component modifications that, according to the manufacturer's specifications, are specially designed to enable the bearings to operate at speeds exceeding 2·3 million DN.

2A002

Other ball bearings or solid roller bearings (except tapered roller bearings) having tolerances specified by the manufacturer in accordance with ISO Standard Class 2 (Annular Bearing Engineers Committee (ABEC) 9, ABEC 9P or better).

2A003

Solid tapered roller bearings, having tolerances specified by the manufacturer in accordance with American National Standards Institute (ANSI)/Anti—Friction Bearing Manufacturers Association (AFBMA) Class 00 (inch) or Class A (metric) or better and having either of the following characteristics:

(a) With lubricating elements or component modifications that, according to the manufacturer's specifications, are specially designed to enable the bearings to operate at speeds exceeding 2·3 million DN; or

(b) Manufactured for use at operating temperatures below 219 K (−54°C) or above 423 K (150°C).

2A004

Gas—lubricated foil bearings manufactured for use at operating temperatures of561 K (288°C) or higher and with a unit load capacity exceeding 1 MPa.

2A005

Active magnetic bearing systems.

2A006

Fabric—lined self—aligning or fabric—lined journal sliding bearings manufactured for use at operating temperatures below 219 K (−54°C) or above 423 K (150°C).

2A007

Components, for goods specified in entries 2A001 to 2A006;

except:

Balls with tolerances specified by the manufacturer in accordance with ISO 3290 as grade 5 or worse.

2A225

Crucibles made of materials resistant to liquid actinide metals, as follows:

(a) Crucibles with a volume of between 150 ml and 8 litres and made of or coated with any of the following materials having a purity of 98% or greater:

1. Calcium fluoride (CaF_2);
2. Calcium zirconate (metazirconate) (Ca_2ZrO_3);
3. Cerium sulphide (Ce_2S_3);
4. Erbium oxide (erbia) (Er_2O_3);
5. Hafnium oxide (hafnia) (HfO_2);
6. Magnesium oxide (MgO);
7. Nitrided niobium—titanium—tungsten alloy (approximately 50% Nb, 30% Ti, 20%W);
8. Yttrium oxide (yttria) (Y_2O_3); or
9. Zirconium oxide (zirconia) (ZrO_2);

(b) Crucibles with a volume of between 50 ml and 2 litres and made of or lined with tantalum, having a purity of 99·9% or greater;

(c) Crucibles with a volume of between 50 ml and 2 litres and made of or lined with tantalum (having a purity of 98% or greater) coated with tantalum carbide, nitride or boride (or any combination of these).

2A226

Valves 5 mm or greater in diameter, with a bellows seal, wholly made of or lined with aluminium, aluminium alloy, nickel or alloy containing 60% or more nickel, either manually or automatically operated.

Test, Inspection and Production Equipment

2B Note: Entries 2B001 to 2B009 do not specify measuring interferometer systems, without closed or open loop feedback, containing a laser to measure slide movement errors of machine—tools, dimensional inspection machines or similar equipment.

2B001

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

Technical Notes:

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

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

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

(a) Numerical control units for machine tools, as follows, and specially designed components therefor:

Note:Head a. of this entry does not specify numerical control units:

(a) Modified for and incorporated in machines not specified in this entry; or

(b) Specially designed for machines not specified in this entry.

(1) Having more than four interpolating axes which can be coordinated simultaneously for contouring control;

(2) Having two, three or four interpolating axes which can be coordinated simultaneously for contouring control and:

(a) Capable of real time processing of data to modify, during the machining operation, tool path, feed rate and spindle data by either:

(1) Automatic calculation and modification of part programme data for machining in two or more axes by means of measuring cycles and access to source data; or

(2) Adaptive control with more than one physical variable measured and processing by means of a computing model (strategy) to change one or more machining instructions to optimize the process;

(b) Capable of receiving directly (on—line) and processing computer aided design (CAD) data for internal preparation of machine instructions; or

(c) Capable, without modification, according to the manufacturer's technical specifications, of accepting additional boards which would permit an increase above the levels specified in this entry, in the number of interpolating axes which can be coordinated simultaneously for contouring control, even if they do not contain these additional boards;

(b) Motion control boards specially designed for machine tools and having any of the following characteristics:

(1) Interpolation in more than four axes;

(2) Capable of real time processing as described in sub—head a.2.a. of this entry; or

(3) Capable of receiving and processing CAD data as described in sub—head a.2.b. of this entry;

(c) Machine tools, as follows, for removing or cutting metals, ceramics or composites, which, according to the manufacturer's technical specifications, can be equipped with electronic devices for simultaneous contouring control in two or more axes:

(1) Machine tools for turning, grinding, milling or any combination thereof which:

(a) Have two or more axes which can be coordinated simultaneously for contouring control; and

(b) Have any of the following characteristics:

(1) Two or more contouring rotary axes;

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

(2) One or more contouring tilting spindles;

Note: Sub—head c.1.b.2. of this entry applies to machine tools for grinding or milling only.

(3) Camming (axial displacement) in one revolution of the spindle less (better) than 0·0006mm total indicator reading (TIR);

Note: Sub—head c.1.b.3. of this entry applies to machine tools for turning only.

(4) Run out (out—of—true running) in one revolution of the spindle less (better) than 0·0006mm TIR;

(5) The positioning accuracies, with all compensations available, are less (better) than:

(a) 0·001° on any rotary axis; or

(b) (1) 0·004mm along any linear axis (overall positioning) for grinding machines;

(2) 0·006mm along any linear axis (overall positioning) for turning or milling machines; or

Note: Sub—head c.1.b.5. of this entry does not specify milling or turning machine tools with a positioning accuracy along one axis, with all compensations available, equal to or more (worse) than 0·005mm.

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

(a) Test conditions (paragraph 3):

(1) For 12 hours before and during measurements, the machine tool and accuracy measuring equipment will be kept at the same ambient temperature. During the premeasurement time the slides of the machine will be continuously cycled in the same manner that the accuracy measurements will be taken;

(2) The machine shall be equipped with any mechanical, electronic, or software compensation to be exported with the machine;

(3) Accuracy of measuring equipment for the measurements shall be at least four times more accurate than the expected machine tool accuracy;

(4) Power supply for slide drives shall be as follows:

(a) Line voltage variation shall not exceed ±10% of nominal rated voltage;

(b) Frequency variation shall not exceed ±2Hz of normal frequency;

(c) Lineouts or interrupted service are not permitted.

(b) Test programme (paragraph 4):

(1) Feed rate (velocity of slides) during measurement shall be the rapid traverse rate;

N.B.: In the case of machine tools which generate optical quality surfaces, the feed rate shall be equal to or less than 50mm per minute;

(2) Measurements shall be made in an incremental manner from one limit of the axis travel to the other without returning to the starting position for each move to the target position;

(3) Axes not being measured shall be retained at mid travel during test of an axis;

(c) Presentation of test results (paragraph 2):

The results of the measurements must include:

(1) Positioning accuracy (A); and

(2) The mean reversal error (B).

(a) (6) (a) A positioning accuracy less (better) than 0·007mm; and

(b) A slide motion from rest for all slides within 20% of a motion command input for inputs of less than 0·5 micrometre;

Technical Note: Minimum increment of motion test (slide motion from rest):

The test is conducted only if the machine tool is equipped with a control unit the minimum increment of which is less (better) than 0·5 micrometre. Prepare the machine for testing in accordance with ISO 230/2 paragraphs 3.1, 3.2, 3.3.

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

(a) Move the axis over at least 50% of the maximum travel in plus and minus directions twice at maximum feed rate, rapid traverse rate or jog control;

(b) Wait at least 10 seconds;

(c) With manual data input, input the minimum programmable increment of the control unit;

(d) Measure the axis movement;

(e) Clear the control unit with the servo null, reset or whatever clears any signal (voltage) in the servo loop;

(f) Repeat steps b. to e. above five times, twice in the same direction of the axis travel and three times in the opposite direction of travel for a total of six test points;

(g) If the axis movement is between 80% and 120% of the minimum programmable input for four of the six test points, the machine is controlled.

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

Notes:

1. Sub—head c.1. of this entry does not specify cylindrical external, internal and external—internal grinding machines having all of the following characteristics:

(a) Not centreless (shoe—type) grinding machines;

(b) Limited to cylindrical grinding;

(c) A maximum workpiece capacity of 150mm outside diameter or length;

(d) Only two axes which can be coordinated simultaneously for contouring control; and

(e) No contouring c axis.

2. Sub—head c.1. of this entry does not specify machines designed specifically as jig grinders having both of the following characteristics:

(a) Axes limited to x, y, c and a, where the c axis is used to maintain the grinding wheel normal to the work surface and the a axis is configured to grind barrel cams; and

(b) A spindle run out not less (not better) than 0·0006mm.

3. Sub—head c.1. of this entry does not specify tool or cutter grinding machines having all of the following characteristics:

(a) Shipped as a complete system with software specially designed for the production of tools or cutters;

(b) No more than two rotary axes which can be coordinated simultaneously for contouring control;

(c) Run out (out—of—true running) in one revolution of the spindle not less (not better) than 0·0006mm TIR; and

(d) The positioning accuracies, with all compensations available, are not less (not better) than:

(1) 0·004mm along any linear axis for overall positioning; or

(2) 0·001° on any rotary axis.

(2) Electrical discharge machines (EDM) of the wire feed type which have five or more axes which can be coordinated simultaneously for contouring control;

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

(4) Machine tools for removing metals, ceramics or composites:

(a) By means of:

(1) Water or other liquid jets, including those employing abrasive additives;

(2) Electron beam; or

(3) Laser beam; and

(b) Having two or more rotary axes which:

(1) Can be coordinated simultaneously for contouring control; and

(2) Have a positioning accuracy of less (better) than 0·003°.

Technical Note: Machines capable of being simultaneously coordinated for contouring control, in two or more rotary axes or one or more tilting spindles, are specified in this entry regardless of the number of simultaneously coordinated contouring axes that can be controlled by the numerical control unit attached to the machine.

2B002

Non—numerically controlled machine tools for generating optical quality surfaces, as follows:

(a) Turning machines using a single point cutting tool and having all of the following characteristics:

1. Slide positioning accuracy less (better) than 0·0005mm per 300mm of travel;
2. Bidirectional slide positioning repeatability less (better) than 0·00025mm per 300mm of travel;
3. Spindle run out and camming less (better) than 0·0004mm TIR;
4. Angular deviation of the slide movement (yaw, pitch and roll) less (better) than 2 seconds of arc, TIR, over full travel; and
5. Slide perpendicularity less (better) than 0·001mm per 300mm of travel;

Technical Note: The bidirectional slide positioning repeatability (R) of an axis is the maximum value of the repeatability of positioning at any position along or around the axis determined using the procedure and under the conditions specified in part 2·11 of ISO 230/2: 1988.

(b) Fly cutting machines having both of the following characteristics:

1. Spindle run out and camming less (better) than 0·0004mm TIR; and
2. Angular deviation of slide movement (yaw, pitch and roll) less (better) than2 seconds of arc, TIR, over full travel.

2B003

Numerically controlled or manual machine tools specially designed for cutting, finishing, grinding or honing either of the following classes of bevel or parallel axis hardened (Rc=40 or more) gears, and specially designed components, controls and accessories therefor:

(a) Hardened bevel gears finished to a quality of better than ISO 1328 class 4; or

(b) Hardened spur, helical and double—helical gears with a pitch diameter exceeding 1,250mm and a face width of 15% of pitch diameter or larger finished to a quality of ISO 1328 class 3 or better.

2B004

Hot isostatic presses, as follows, and specially designed dies, moulds, components, accessories and controls therefor(**19**):

(a) Having a controlled thermal environment within the closed cavity and possessing a chamber cavity with an inside diameter of 406mm or more; and

(b) Having:

1. A maximum working pressure exceeding 207MPa;
2. A controlled thermal environment exceeding 1,773K (1,500°C); or
3. A facility for hydrocarbon impregnation and removal of resultant gaseous degradation products.

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

2B005

Equipment specially designed for the deposition, processing and in—process control of inorganic overlays, coatings and surface modifications, as follows, for non—electronic substrates, by processes shown in the Table and associated Notes following head d. of entry 2E003, and specially designed automated handling, positioning, manipulation and control components therefor:

(a) Stored programme controlled chemical vapour deposition (CVD) production equipment with both of the following:

1. Process modified for one of the following:
   a. Pulsating CVD;
   b. Controlled nucleation thermal decomposition (CNTD); or
   c. Plasma enhanced or plasma assisted CVD; and
2. Either of the following:
   a. Incorporating high vacuum (equal to or less than 0·01Pa) rotating seals; or
   b. Incorporating in situ coating thickness control;

(b) Stored programme controlled ion implantation production equipment having beam currents of 5mA or more;

(c) Stored programme controlled electron beam physical vapour deposition (EB—PVD) production equipment incorporating:

1. Power systems rated for over 80kW;
2. A liquid pool level laser control system which regulates precisely the ingots feed rate; and

(**19**) See also Entries 2B104 and 2B204.

3. A computer controlled rate monitor operating on the principle of photoluminescence of the ionised atoms in the evaporant stream to control the deposition rate of a coating containing two or more elements;

(d) Stored programme controlled plasma spraying production equipment having either of the following characteristics:

1. Operating at reduced pressure controlled atmosphere (equal to or less than 10kPa measured above and within 300mm of the gun nozzle exit) in a vacuum chamber capable of evacuation down to 0·01Pa prior to the spraying process; or

2. Incorporating in situ coating thickness control;

(e) Stored programme controlled sputter deposition production equipment capable of current densities of 0·1mA/mm^2 or higher at a deposition rate of 15 micrometre/hr or more;

(f) Stored programme controlled cathodic arc deposition production equipment incorporating a grid of electromagnets for steering control of the arc spot on the cathode;

(g) Stored programme controlled ion plating production equipment allowing for the in situ measurement of either:

1. Coating thickness on the substrate and rate control; or

2. Optical characteristics.

Note: Head g. of this entry does not specify standard ion plating coating equipment for cutting or machining tools.

2B006

Dimensional inspection or measuring systems or equipment, as follows:

(a) Computer controlled, numerically controlled or stored programme controlled dimensional inspection machines, having both of the following characteristics:

1. Two or more axes; and

2. A one dimensional length measurement uncertainty equal to or less (better) than (1·25 + L/1,000) micrometre tested with a probe with an accuracy of less (better) than 0·2 micrometre (L is the measured length in mm);

(b) Linear and angular displacement measuring instruments, as follows:

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

a. Non—contact type measuring systems with a resolution equal to or less (better) than 0·2 micrometre within a measuring range up to 0·2mm;

b. Linear voltage differential transformer systems with both of the following characteristics:

1. Linearity equal to or less (better) than 0·1% within a measuring range up to 5mm; and

2. Drift equal to or less (better) than 0·1% per day at a standard ambient test room temperature ±1K; or

c. Measuring systems having both of the following characteristics:

1. Containing a laser; and

2. Maintaining, for at least 12 hours, over a temperature range of ±1K around a standard temperature and at a standard pressure:

a. A resolution over their full scale of 0·1 micrometre or less (better); and

b. A measurement uncertainty equal to or less (better) than (0·2 + L/2,000) micrometre (L is the measured length in mm);

2. Angular measuring instruments having an angular position deviation equal to or less (better) than 0·00025°;

Note: Sub—head b.2. of this entry does not specify optical instruments, such as autocollimators, using collimated light to detect angular displacement of a mirror.

(c) Systems for simultaneous linear—angular inspection of hemishells, having both of the following characteristics:

(1) Measurement uncertainty along any linear axis equal to or less (better) than3·5 micrometre per 5mm; and

(2) Angular position deviation equal to or less (better) than 0·02°;

(d) Equipment for measuring surface irregularities, by measuring optical scatter as a function of angle, with a sensitivity of 0·5nm or less (better).

Technical Notes:

(1) The probe used in determining the measurement uncertainty of a dimensional inspection system shall be as described in Verein Deutscher Ingenieure (VDI)/ Verband Deutscher Elektrotechniker (VDE) 2617 Parts 2, 3 and 4.

(2) All measurement values in this entry represent permissible positive and negative deviations from the target value, i.e., not total band.

Notes:

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

2. A machine described in this entry is specified if it exceeds the threshold anywhere within its operating range.

3. In this entry measurement uncertainty means the characteristic parameter which specifies in what range around the output value the correct value of the measurable variable lies with a confidence level of 95%. It includes the uncorrected systematic deviations, the uncorrected backlash and the random deviations (Reference: VDI/VDE 2617).

2B007

Robots, as follows, and specially designed controllers and end—effectors therefor(**20**):

(a) Capable in real time of full three—dimensional image processing or full three—dimensional scene analysis to generate or modify programmes or to generate or modify numerical programme data;

Note: The scene analysis limitation does not include approximation of the third dimension by viewing at a given angle, or limited grey scale interpretation for the perception of depth or texture for the approved tasks (21/2D).

(b) Specially designed to comply with national safety standards applicable to explosive munitions environments; or

(c) Specially designed or rated as radiation—hardened beyond that necessary to withstand normal industrial (i.e.,non—nuclear industry) ionizing radiation.

(**20**) See also Entry 2B207.

2B008

Assemblies, units or inserts specially designed for machine tools, or for equipment specified in entries 2B006 or 2B007, as follows:

(a) Spindle assemblies, consisting of spindles and bearings as a minimal assembly, with radial (run out) or axial (camming) axis motion in one revolution of the spindle less (better) than 0·0006mm TIR;

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

(c) Rotary position feedback units, e.g.,inductive type devices, graduated scales, infrared systems or laser systems, having an accuracy less (better) than 0·00025°;

(d) Slide way assemblies consisting of a minimal assembly of ways, bed and slide having all of the following characteristics:

1. A yaw, pitch or roll of less (better) than 2 seconds of arc TIR over full travel;
2. A horizontal straightness of less (better) than 2 micrometre per 300mm length; and
3. A vertical straightness of less (better) than 2 micrometre per 300mm length;

(e) Single point diamond cutting tool inserts, having all of the following characteristics:

1. Flawless and chip—free cutting edge when magnified 400 times in any direction;
2. Cutting radius from 0·1 to 5mm inclusive; and
3. Cutting radius out—of—roundness less (better) than 0·002mm TIR.

2B009

Specially designed printed circuit boards with mounted components and software therefor, or compound rotary tables or tilting spindles, capable of upgrading, according to the manufacturer's specifications, numerical control units, machine tools or feed—back devices to or above the levels specified in entries 2B001 to 2B008.

2B104

Equipment and process controls designed or modified for densification and pyrolysis of structural composite rocket nozzles and reentry vehicle nose tips.

Note: The only isostatic presses and furnaces specified in this entry are as follows:

(a) Isostatic presses, other than those specified in entry 2B004, having all the following characteristics:

1. Maximum working pressure of 69MPa or greater;
2. Designed to achieve and maintain a controlled thermal environment of 873K (600°C) or greater; and
3. Possessing a chamber cavity with an inside diameter of 254mm or greater;

(b) CVD furnaces designed or modified for the densification of carbon—carbon composites.

2B115

Flow—forming machines, and specially designed components therefor(**21**), which:

(**21**) See also entry 2B215.

(a) According to the manufacturer's technical specification, can be equipped with numerical control units or a computer control, even when not equipped with such units; and

(b) With more than two axes which can be coordinated simultaneously for contouring control.

Technical Note: Machines combining the function of spin—forming and flow—forming are for the purpose of this entry regarded as flow—forming machines.

2B116

Vibration test equipment using digital control techniques, and feedback or closed loop test equipment therefor, capable of vibrating a system at 10g RMS or more between 20Hz and 2000Hz and imparting forces of 50kN or greater.

2B204

Isostatic presses, other than those specified in entries 2B004 or 2B104, capable of achieving a maximum working pressure of 69MPa or greater and having a chamber cavity with an inside diameter in excess of 152mm and specially designed dies, moulds and controls therefor.

2B207

Robots and end—effectors, other than those specified in entry 2B007, specially designed to comply with national safety standards applicable to handling high explosives (for example, meeting electrical code ratings for high explosives) and specially designed controllers therefor.

2B215

Spin—forming and flow—forming machines, other than those specified in entry 2B115, and precision rotor—forming mandrels designed to form cylindrical rotors of inside diameter between 75mm and 400mm therefor, which:

(a) According to the manufacturer's technical specification, can be equipped with numerical control units or a computer control; and

(b) With two or more axes that can be coordinated simultaneously for contouring control.

Technical Note: The only spin—forming machines specified in this entry are those combining the function of spin—forming and flow—forming.

2B225

Remote manipulators that provide mechanical translation of human operator actions by electrical, hydraulic or mechanical means to an operating arm and terminal fixture that can be used to provide remote actions in radiochemical separation operations and hot cells, as follows:

(a) Having a capability of penetrating 0·6m or more of cell wall; or

(b) Having a capability to bridge over the top of a cell wall with a thickness of 0·6m or more.

2B226

Vacuum or controlled environment (inert gas) induction furnaces capable of operating above 1,123K (850°C) and having induction coils 600mm or less in diameter and specially designed power supplies therefor with an output rating of 5kW or more(**22**).

Note: This entry does not specify furnaces designed for the processing of semiconductor wafers.

(**22**) See also Sub—category 3B.

2B227

Vacuum and controlled atmosphere metallurgical melting and casting furnaces as follows; and specially configured computer control and monitoring systems therefor:

(a) Arc remelt and casting furnaces with consumable electrode capacities between 1000cm^3 and 20,000cm^3, capable of operating with melting temperatures above 1973K (1700°C);

(b) Electron beam melting and plasma atomization and melting furnaces, with a power of 50kW or greater, capable of operating with melting temperatures above 1473K (1200°C).

2B228

Rotor fabrication and assembly equipment and bellows—forming mandrels and dies, as follows:

(a) Rotor assembly equipment for assembly of gas centrifuge rotor tube sections, baffles and end caps, including associated precision mandrels, clamps and shrink fit machines.

(b) Rotor straightening equipment for alignment of gas centrifuge rotor tube sections to a common axis.

Technical Note: Normally such equipment will consist of precision measuring probes linked to a computer that subsequently controls the action of, for example, pneumatic rams used for aligning the rotor tube sections.

(c) Bellows—forming mandrels and dies for producing single—convolution bellows (bellows made of high—strength aluminium alloys, maraging steel or high strength filamentary materials). The bellows have all of the following dimensions:

1. 75mm to 400mm inside diameter;
2. 12·7mm or more in length; and
3. Single convolution depth more than 2mm.

2B229

Centrifugal multiplane balancing machines, fixed or portable, horizontal or vertical, as follows:

(a) Centrifugal balancing machines designed for balancing flexible rotors having a length of 600mm or more and having all of the following characteristics:

1. A swing or journal diameter of 75mm or more;
2. Mass capability of from 0·9 to 23kg; and
3. Capable of balancing speed of revolution more than 5000rpm;

(b) Centrifugal balancing machines designed for balancing hollow cylindrical rotor components and having all of the following characteristics:

1. A journal diameter of 75mm or more;
2. Mass capability of from 0·9 to 23kg;
3. Capable of balancing to a residual imbalance of 0·01kg mm/kg per plane or better; and
4. Belt drive type.

2B230

Instruments capable of measuring pressures up to 13kPa to an accuracy of better than 1% (full—scale), with corrosion—resistant pressure—sensing elements constructed of nickel, nickel alloys, phosphor bronze, stainless steel, aluminium or aluminium alloys.

2B231

Vacuum pumps with an input throat size of 380mm or greater with a pumping speedof 15,000 litres/s or greater and capable of producing an ultimate vacuum better than13 mPa.

Technical Note: The ultimate vacuum is determined at the input of the pump with the input of the pump blocked off.

2B232

Multistage light gas gun or other high—velocity gun systems (coil, electromagnetic, electrothermal or other advanced systems) capable of accelerating projectiles to 2km/s or greater.

2B350

Chemical manufacturing facilities and equipment, as follows:

(a) Reactor vessels, with or without agitators, with a total volume greater than $0{\cdot}1m^3$ and less than $15m^3$;

(b) Storage tanks and containers, with a total volume greater than $0{\cdot}1m^3$;

(c) Heat exchangers;

(d) Distillation columns of diameter greater than 0·1m;

(e) Condensers;

(f) Degassing equipment;

Note: Heads a. to f. of this entry are only specified when all surfaces that come in direct contact with the chemical(s) being processed or contained are made from any of the following:

a. Nickel or alloys with more than 40% nickel by weight;

b. Alloys with more than 25% nickel and 20% chromium by weight;

c. Glass; or

d. Graphite (for heat exchangers only).

(g) Remotely operated filling equipment in which all surfaces that come in direct contact with the fluid are made from any of the following materials:

1. Nickel or alloys with more than 40% nickel by weight; or

2. Alloys with more than 25% nickel and 20% chromium by weight;

(h) Bellows valves, diaphragm valves or double seal valves incorporating a leak detection port, and multi—walled piping incorporating a leak detection port, in which all surfaces that come in direct contact with the fluids are made from the following materials:

1. Nickel or alloys with more than 40% nickel by weight;

2. Alloys with more than 25% nickel and 20% chromium by weight; or

3. Fluoropolymers including PTFE, PVDF, PFA;

(i) Double—seal, canned drive, magnetic drive, bellows or diaphragm pumps in which all surfaces that come in direct contact with the fluid are made from the following materials:

1. Nickel or alloys with more than 40% nickel by weight;

2. Alloys with more than 25% nickel and 20% chromium by weight;

3. Fluoropolymers including PTFE, PVDF, PFA; or

4. Tantalum;

(j) Incinerators designed to destroy chemicals specified in entry 1C350, with special handling facilities, with an average combustion chamber temperature greater than 1273K (1000°C), in which all surfaces in the waste supply system that come into direct contact with the waste products are made from or lined with the following materials:

1. Nickel or alloys with more than 40% nickel by weight;
2. Alloys with more than 25% nickel and 20% chromium by weight; or
3. Ceramics.

2B351

Toxic gas monitoring systems, with the following characteristics:

(a) Capable of detecting chemical warfare agents and chemicals specified in entry 1C350 as well as phosphorus, sulphur, fluorine, chlorine or their compounds, at a concentration of less than $0{\cdot}3 mg/m^3$ of air and capable of continuous operation; or

(b) Capable of detecting compounds having an anticholinesterase function.

2B352

Equipment capable of use in biological manufacturing, as follows;

(a) Containment facilities at Containment Level (ACDP) 3 or 4, and related equipment, as follows:

1. Facilities that meet the criteria for Containment Level 3 or 4 as specified in guidance from the Advisory Committee on Dangerous Pathogens approved by the Health and Safety Commission (published by HMSO, Second Edition 1990);

   Note: The criteria for Containment Level 3 or 4 in head a.of this entry are equivalent to the criteria for P3 or P4, BL3 or BL4, L3 or L4 containment as specified in the WHO Laboratory Biosafety manual (Geneva, 1983).
2. Independently ventilated protective full or half suits;
3. Biological safety cabinets or isolators, which allow manual operations to be performed within, whilst providing an environment equivalent to Class III biological protection;

   Note: In this entry, isolators include flexible isolators, dry boxes, anaerobic chambers and glove boxes.

(b) Fermenters, bioreactors, chemostats and continuous—flow systems, capable of operation without the propagation of aerosols, having all the following characteristics:

1. Capacity of 300 litres or more;
2. Double or multiple sealing joints within the steam containment area; and
3. Capable of in—situ sterilisation in a closed state;

(c) Centrifugal separators or decanters, capable of continuous separation without the propagation of aerosols, having all the following characteristics:

1. Flow rate exceeding 100 litres per hour;
2. Components of polished stainless steel or titanium;
3. Double or multiple sealing joints within the steam containment area; and
4. Capable of in—situ sterilisation in a closed state;

(d) Cross—flow filtration equipment, designed for continuous separation without the propagation of aerosols, having both of the following characteristics:

1. Equal to or greater than 5 square metres; and
2. Capable of in—situ sterilisation;

(e) Steam sterilisable freeze drying equipment with a condenser capacity exceeding 50 kg of ice in 24 hours and less than 1,000 kg of ice in 24 hours;

(f) Chambers designed for aerosol challenge testing with pathogenic microorganisms or toxins and having a capacity of 1 m^3 or greater.

Materials

2C None.

Software

2D

2D001

Software specially designed or modified for the development, production or use of goods specified in entries 2A001 to 2A007 or 2B001 to 2B009.

2D002

Specific software, as follows:

(a) Software to provide adaptive control and having both of the following characteristics:

1. For flexible manufacturing units (FMUs) which consist at least of equipment described in b.1. and b.2. of the definition of flexible manufacturing unit; and
2. Capable of generating or modifying, in real time processing, programmes or data by using the signals obtained simultaneously by means of at least two detection techniques, such as:
   a. Machine vision (optical ranging);
   b. Infrared imaging;
   c. Acoustical imaging (acoustical ranging);
   d. Tactile measurement;
   e. Inertial positioning;
   f. Force measurement;
   g. Torque measurement;

   Note: Head a. of this entry does not specify software which only provides rescheduling of functionally identical equipment within flexible manufacturing units using pre—stored part programmes and a pre—stored strategy for the distribution of the part programmes.

(b) Software for electronic devices other than those described in heads a. or .b of entry 2B001, which provides the numerical control capability of the goods specified in entry 2B001.

Note: Entry 2B001 and this entry specify any combination of electronic devices or systems that collectively contain software enabling such devices or systems to function as a numerical control unit capable of coordinating simultaneously more than 4 axes for contouring control.

2D101

Software specially designed for the use of goods specified in entries 2B104, 2B115 or 2B116(**23**).

2D201

Software specially designed for the use of goods specified in entries 2B204, 2B207, 2B215, 2B227 or 2B229.

Technology

2E

2E001

Technology required for the development of goods specified in sub—categories 2A, 2B or 2D.

2E002

Technology required for the production of goods specified in sub—categories 2A or 2B.

2E003

The export of goods specified in this entry is only prohibited to any destination in any country listed in Schedule 2.

Other technology, as follows:

(a) Technology:

1. For the development of interactive graphics as an integrated part in numerical control units for preparation or modification of part programmes;
2. For the development of generators of machine tool instructions (e.g., part programmes) from design data residing inside numerical control units;
3. For the development of integration software for incorporation of expert systems for advanced decision support of shop floor operations into numerical control units;

(b) Technology for metal—working manufacturing processes, as follows:

1. Technology for the design of tools, dies or fixtures specially designed for the following processes:
   a. Superplastic forming;
   b. Diffusion bonding;
   c. Direct—acting hydraulic pressing;
2. Technical data consisting of process methods or parameters as listed below used to control:

(a) Superplastic forming of aluminium alloys, titanium alloys or superalloys:

1. Surface preparation;
2. Strain rate;
3. Temperature;
4. Pressure;

(b) Diffusion bonding of superalloys or titanium alloys:

(**23**) See also entry 9D004(a).

1. Surface preparation;
2. Temperature;
3. Pressure;

(c) Direct—acting hydraulic pressing of aluminium alloys or titanium alloys:

1. Pressure;
2. Cycle time;

(d) Hot isostatic densification of titanium alloys, aluminium alloys or superalloys:

1. Temperature;
2. Pressure;
3. Cycle time;

(c) Technology for the development or production of hydraulic stretch—forming machines and dies therefor, for the manufacture of airframe structures;

(d) Technology for:

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

To non—electronic substrates, specified in column 2 of the following Table;

By processes specified in column 1 of the following Table and defined in the Technical Note;

&The numbers in parenthesis refer to the Notes following this Table.)

Table—Deposition Techniques

1.Coating Process (1)&	*2.Substrate*	*3.Resultant Coating*
A. Chemical Vapour Deposition (CVD)	Superalloys	Aluminides for internal passages
	Ceramics and low—expansion glasses (14)	Silicides
		Carbides
		Dielectric layers (15)
	Carbon—carbon, ceramic and metal matrix composites	Silicides
		Carbides
		Refractory metals
		Mixtures thereof (4)
		Dielectric layers (15)
		Aluminides
		Alloyed aluminides (2)
	Cemented tungsten carbide (16), silicon carbide	Carbides
		Tungsten

1.Coating Process (1)&	*2.Substrate*	*3.Resultant Coating*
		Mixtures thereof (4)
		Dielectric layers (15)
		Dielectric layers (15)
	Molybdenum and molybdenum alloys Beryllium and beryllium alloys	Dielectric layers (15)
	Sensor window materials (9)	Dielectric layers (15)
B. Thermal—Evaporation Physical Vapour Deposition (TE—PVD)		
1. Physical Vapour Deposition (PVD): Electron—Beam (EB—PVD)	Superalloys	Alloyed silicides
		Alloyed aluminides (2)
		MCrA1X (5)
		Modified zirconia (12)
		Silicides
		Aluminides
		Mixtures thereof (4)
	Ceramics and low—expansion glasses (14)	Dielectric layers (15)
	Corrosion resistant steel (7)	MCrA1X (5)
		Modified zirconia (12)
		Mixtures thereof (4)
	Carbon—carbon, ceramic and metal matrix composites	Silicides
		Carbides
		Refractory metals
		Mixtures thereof (4)
		Dielectric layers (15)
	Cemented tungsten carbide (16), silicon carbide	Carbides
		Tungsten
		Mixtures thereof (4)

1.Coating Process (1)&	*2.Substrate*	*3.Resultant Coating*
		Dielectric layers (15)
	Molybdenum and molybdenum alloys	Dielectric layers (15)
	Beryllium and beryllium alloys	Dielectric layers (15)
		Borides
	Sensor window materials (9)	Dielectric layers (15)
	Titanium alloys (13)	Borides
		Nitrides
B.2. Ion assisted resistive heating Physical Vapour Deposition (Ion Plating)	Ceramics and low—expansion glasses (14)	Dialectric layers (15)
	Carbon—carbon, ceramic and metal matrix composites	Dielectric layers (15)
	Cemented tungsten carbide (16), silicon carbide	Dielectric layers (15)
	Molybdenum and molybdenum alloys	Dielectric layers (15)
	Beryllium and beryllium alloys	Dielectric layers (15)
	Sensor window materials (9)	Dielectric layers (15)
B.3. Physical Vapour Deposition: laser evaporation	Ceramics and low—expansion glasses (14)	Silicides
		Dielectric layers (15)
	Carbon—carbon, ceramic and metal matrix composites	Dielectric layers (15)
	Cemented tungsten carbide (16), silicon carbide	Dielectric layers (15)
	Molybdenum and molybdenum alloys	Dielectric layers (15)
	Beryllium and beryllium alloys	Dielectric layers (15)
	Sensor window materials (9)	Dielectric layers (15)
		Diamond—like carbon
B.4. Physical Vapour Deposition: cathodic arc discharge	Superalloys	Alloyed silicides
		Alloyed aluminides (2)
		MCrA1X (5)

1.Coating Process (1)&	*2.Substrate*	*3.Resultant Coating*
	Polymers (11) and organic matrix composites	Borides
		Carbides
		Nitrides
C. Pack cementation (see A above for out—of—pack cementation) (10)	Carbon—carbon, ceramic and metal matrix composites	Silicides
		Carbides
		Mixtures thereof (4)
	Titanium alloys (13)	Silicides
		Aluminides
		Alloyed aluminides (2)
	Refractory metals and alloys (8)	Silicides
		Oxides
D. Plasma spraying	Superalloys	MCrA1X (5)
		Modified zirconia (12)
		Mixtures thereof (4)
		Abradable Nickel—Graphite
		Abradable Ni—Cr—Al—Bentonite
		Abradable Al—Si—Polyester
		Alloyed aluminides (2)
	Aluminium alloys (6)	MCrA1X (5)
		Modified zirconia (12)
		Silicides
		Mixtures thereof (4)
	Refractory metals and alloys (8)	Aluminides
		Silicides
		Carbides
	Corrosion resistant steel (7)	Modified zirconia (12)
		Mixtures thereof (4)

1.Coating Process (1)&	*2.Substrate*	*3.Resultant Coating*
	Titanium alloys (13)	Carbides
		Aluminides
		Silicides
		Alloyed aluminides (2)
		Abradable Nickel—Graphite
		Abradable
		Ni—Cr—Al—Bentonite
		Abradable Al—Si—Polyester
E. Slurry Deposition	Refractory metals and alloys (8)	Fused silicides
		Fused aluminides except for resistance heating elements
	Carbon—carbon, ceramic and metal matrix composites	Silicides
		Carbides
		Mixtures thereof (4)
F. Sputter Deposition	Superalloys	Alloyed silicides
		Alloyed aluminides (2)
		Noble metal modified aluminides (3)
		MCrA1X (5)
		Modified zirconia (12)
		Platinum
		Mixtures thereof (4)
	Ceramics and low—expansion glasses (14)	Silicides
		Platinum
		Mixtures thereof (4)
		Dielectric layers (15)
	Titanium alloys (13)	Borides
		Nitrides

1.Coating Process (1)&	*2.Substrate*	*3.Resultant Coating*
		Oxides
		Silicides
		Aluminides
		Alloyed aluminides (2)
		Carbides
	Carbon—carbon, ceramic and metal matrix composites	Silicides
		Carbides
		Refractory metals
		Mixtures thereof (4)
		Dielectric layers (15)
	Cemented tungsten carbide (16), silicon carbide	Carbides
		Tungsten
		Mixtures thereof (4)
		Dielectric layers (15)
	Molybdenum and molybdenum alloys	Dielectric layers (15)
	Beryllium and beryllium alloys	Borides
		Dielectric layers (15)
	Sensor window materials (9)	Dielectric layers (15)
	Refractory metals and alloys (8)	Aluminides
		Silicides
		Oxides
		Carbides
G. Ion Implantation	High temperature bearing steels	Additions of chromium, tantalum or niobium (columbium)
	Titanium alloys (13)	Borides
		Nitrides
	Beryllium and beryllium alloys	Borides

1.Coating Process (1)&	*2.Substrate*	*3.Resultant Coating*
	Cemented tungsten carbide (16)	Carbides
		Nitrides

Table—Deposition Techniques—Notes

(1) The term `coating process' includes coating repair and refurbishing as well as original coating.

(2) The term `alloyed aluminide coating' includes single or multiple—step coatings in which an element or elements are deposited prior to or during application of the aluminide coating, even if these elements are deposited by another coating process. It does not, however, include the multiple use of single—step pack cementation processes to achieve alloyed aluminides.

3. The term `noble metal modified aluminide' coating includes multiple—step coatings in which the noble metal or noble metals are laid down by some other coating process prior to application of the aluminide coating.

4. Mixtures consist of infiltrated material, graded compositions, co—deposits and multilayer deposits and are obtained by one or more of the coating processes specified in the Table.

5. MCrAlX refers to a coating alloy where M equals cobalt, iron, nickel or combinations thereof and X equals hafnium, yttrium, silicon, tantalum in any amount or other intentional additions over 0·01 weight percent in various proportions and combinations; except:

(a) CoCrAlY coatings which contain less than 22 weight percent of chromium, less than 7 weight percent of aluminium and less than 2 weight percent of yttrium;

(b) CoCrAlY coatings which contain 22 to 24 weight percent of chromium, 10 to 12 weight percent of aluminium and 0·5 to 0·7 weight percent of yttrium; or

(c) NiCrAlY coatings which contain 21 to 23 weight percent of chromium, 10 to 12 weight percent of aluminium and 0·9 to 1·1 weight percent of yttrium.

6. The term `aluminium alloys' refers to alloys having an ultimate tensile strength of 190MPa or more measured at 293K (20°C).

7. The term `corrosion resistant steel' refers to AISI (American Iron and Steel Institute) 300 series or equivalent national standard steels.

8. Refractory metals consist of the following metals and their alloys: niobium (columbium), molybdenum, tungsten and tantalum.

9. Sensor window materials, as follows: alumina, silicon, germanium, zinc sulphide, zinc selenide, gallium arsenide and the following metal halides: potassium iodide, potassium fluoride, or sensor window materials of more than 40mm diameter for thallium bromide and thallium chlorobromide.

10. Technology for single—step pack cementation of solid airfoils is not specified in Category 2.

(11) Polymers, as follows: polyimide, polyester, polysulphide, polycarbonates and polyurethanes.

(12) Modified zirconia refers to additions of other metal oxides, e.g., calcia, magnesia, yttria, hafnia, rare earth oxides, etc, to zirconia in order to stabilise certain crystallographic phases and phase compositions. Thermal barrier coatings made of zirconia, modified with calcia or magnesia by mixing or fusion, are not controlled.

(13) Titanium alloys refers to aerospace alloys having an ultimate tensile strength of 900 MPa or more measured at 293K (20°C).

(14) Low—expansion glasses refers to glasses which have a coefficient of thermal expansion of $1\times10^{7}-K^{1}-$ or less measured at 293K (20°C).

(15) Dielectric layers are coatings constructed of multi—layers of insulator materials in which the interference properties of a design composed of materials of various refractive indices are used to reflect, transmit or absorb various wavelength bands. Dielectric layers refers to more than four dielectric layers or dielectric/metal composite layers.

(16) Cemented tungsten carbide does not include cutting and forming tool materials consisting of tungsten carbide/(cobalt, nickel), titanium carbide/(cobalt, nickel), chromium carbide/nickel—chromium and chromium carbide/nickel.

Table—Deposition Techniques—Technical Note

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

(a) Chemical Vapour Deposition (CVD) is an overlay coating or surface modification coating process wherein a metal, alloy, composite, dielectric or ceramic is deposited upon a heated substrate. Gaseous reactants are decomposed or combined in the vicinity of a substrate resulting in the deposition of the desired elemental, alloy or compound material on the substrate.

Energy for this decomposition or chemical reaction process may be provided by the heat of the substrate, a glow discharge plasma, or laser irradiation.

Notes:

1. CVD includes the following processes: directed gas flow out—of—pack deposition, pulsating CVD, controlled nucleation thermal decomposition (CNTD), plasma enhanced or plasma assisted CVD processes.
2. Pack denotes a substrate immersed in a powder mixture.
3. The gaseous reactants used in the out—of—pack process are produced using the same basic reactions and parameters as the pack cementation process, except: that the substrate to be coated is not in contact with the powder mixture.

(b) Thermal Evaporation—Physical Vapour Deposition (TE—PVD) is an overlay coating process conducted in a vacuum with a pressure less than 0·1Pa wherein a source of thermal energy is used to vaporize the coating material. This process results in the condensation, or deposition, of the evaporated species onto appropriately positioned substrates.

The addition of gases to the vacuum chamber during the coating process to synthesize compound coatings is an ordinary modification of the process.

The use of ion or electron beams, or plasma, to activate or assist the coating's deposition is also a common modification in this technique. The use of monitors to provide in—process measurement of optical characteristics and thickness of coatings can be a feature of these processes.

Specific TE—PVD processes are as follows:

1. Electron beam PVD uses an electron beam to heat and evaporate the material which forms the coating;
2. Resistive heating PVD employs electrically resistive heating sources capable of producing a controlled and uniform flux of evaporated coating species;
3. Laser evaporation uses either pulsed or continuous wave laser beams to heat the material which forms the coating;

4. Cathodic arc deposition employs a consumable cathode of the material which forms the coating and has an arc discharge established on the surface by a momentary contact of a ground trigger. Controlled motion of arcing erodes the cathode surface creating a highly ionized plasma. The anode can be either a cone attached to the periphery of the cathode, through an insulator, or the chamber. Substrate biasing is used for non line—of—sight deposition.

   Note: This definition does not include random cathodic arc deposition with non—biased substrates.

(c) Ion plating is a special modification of a general TE—PVD process in which a plasma or an ion source is used to ionize the species to be deposited, and a negative bias is applied to the substrate in order to facilitate the extraction of the species to be deposited from the plasma. The introduction of reactive species, evaporation of solids within the process chamber, and the use of monitors to provide in—process measurement of optical characteristics and thicknesses of coatings are ordinary modifications of the process.

(d) Pack cementation is a surface modification coating or overlay coating process wherein a substrate is immersed in a powder mixture (a pack), that consists of:

1. The metallic powders that are to be deposited (usually aluminium, chromium, silicon or combinations thereof);
2. An activator (normally a halide salt); and
3. An inert powder, most frequently alumina.

   The substrate and powder mixture is contained within a retort which is heated to between 1,030K (757°C) and 1,375K (1,102°C) for sufficient time to deposit the coating.

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

Notes:

1. Low pressure means less than ambient atmospheric pressure.
2. High velocity refers to nozzle—exit gas velocity exceeding 750m/s calculated at 293K (20°C) at 0·1MPa.

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

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

Notes:

1. The Table refers only to triode, magnetron or reactive sputter deposition which is used to increase adhesion of the coating and rate of deposition and to radio frequency (RF) augmented sputter deposition used to permit vapourisation of non—metallic coating materials.
2. Low—energy ion beams (less than 5 keV) can be used to activate the deposition.

(h) Ion implantation is a surface modification coating process in which the element to be alloyed is ionized, accelerated through a potential gradient and implanted into the surface region of the substrate. This includes processes in which ion implantation is performed simultaneously with electron beam physical vapour deposition or sputter deposition.

2E101

Technology required for the use of equipment or software specified in entries 2B004, 2B104, 2B115, 2B116 or 2D101.

2E201

Technology required for the use of equipment or software specified in entries 2A225, 2A226, 2B001, 2B006, head b. of entry 2B007, head c. of entry 2B007, or entries 2B008, 2B009, 2B204, 2B207, 2B215, 2B225 to 2B232 or 2D201.
Category 3Electronics

Equipment, Assemblies and Components

3A

3A

Notes:

1. For equipment, devices and components described in sub—category 3A, other than those described in sub—heads a.3. to a.10. of this entry, which are specially designed for, or which have the same functional characteristics as other equipment, refer to the entry that specifies such equipment.

2. For integrated circuits described in sub—heads a.3. to a.9. of this entry, which are unalterably programmed or designed for a specific function, refer to the entry that specifies equipment with that function.

NB: Where it cannot be determined that the specific function is specified in another entry, the integrated circuits are evaluated against the parameters in sub—heads a.3. to a.9. of this entry.

3A001

Electronic devices and components:

(a) General purpose integrated circuits, as follows:

Notes:

1. Wafers (finished or unfinished), in which the function has been determined, are evaluated against the parameters of this head.
2. Integrated circuits include the following types:

Monolithic integrated circuits;

Hybrid integrated circuits;

Multichip integrated circuits;

Film type integrated circuits, including silicon—on—sapphireintegrated circuits;

Optical integrated circuits.

3. Integrated circuits, designed or rated as radiation hardened to withstand a total dose of 5×10^5 rad (Si), or higher;

4. Note: For integrated circuits designed or rated against neutron or transient ionising radiation, see Group 1 of Part III of this Schedule.

5. Integrated circuits described in sub—heads a.3. to a.10. of this entry, rated for operation at an ambient temperature below 219 K (−54°C) or above 398 K (125°C);

6. Note: Sub—head a.2. of this entry does not apply to integrated circuits for civil automobiles or railway engines.

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

   Notes:

   1. Sub—head a.3. of this entry does not specify silicon—based microcomputer microcircuits or microcontroller microcircuits having an operand (data) word length of 8 bits or less and not covered by Note 2 to 3A.

   2. Sub—head a.3. of this entry includes digital signal processors, digital array processors and digital coprocessors.

(a) An external data bus width exceeding 32 bit or an arithmetic logic unit with an access width exceeding 32 bit;

(b) A clock frequency exceeding 40 MHz;

(c) An external data bus width of 32 bit or more and capable of executing 12·5 million instructions per second (MIPS) or more; or

Technical Note: If MIPS are not specified, the inverse of the average instruction cycle time (in microseconds) should be used.

(d) More than one data or instruction bus or serial communication port for external interconnection in a parallel processor with a transfer rate exceeding 2·4 Mbyte/s;

4. Storage integrated circuits, as follows:

(a) Electrical erasable programmable read—only memories (EEPROMs) with a storage capacity:

(1) Exceeding 1 Mbit per package; or

(2) Exceeding 256 kbit per package and a maximum access time of less than 80 ns;

(b) Static random—access memories (SRAMs) with a storage capacity:

(1) Exceeding 1 Mbit per package; or

(2) Exceeding 256 kbit per package and a maximum access time of less than 25 ns;

(c) Storage integrated circuits manufactured from a compound semiconductor;

5. Converter integrated circuits, as follows:

(a) Analogue—to—digital converters having any of the following:

(1) A resolution of 8 bit or more, but less than 12 bit, with a total conversion time to maximum resolution of less than 10 ns;

(2) A resolution of 12 bit with a total conversion time to maximum resolution of less than 200 ns; or

(3) A resolution of more than 12 bit with a total conversion time to maximum resolution of less than 2 microseconds;

(b) Digital—to—analogue converters with a resolution of 12 bit or more, and a settling time of less than 10 ns;

6. Electro—optical or optical integrated circuits for signal processing having all of the following:

(a) One or more internal laser diodes;

(b) One or more internal light detecting elements; and

(c) Optical waveguides;

7. Field programmable gate arrays having either of the following:

(a) An equivalent gate count of more than 30,000 (2 input gates); or

(b) A typical basic gate propagation delay time of less than 0·4 ns;

8. Field programmable logic arrays having either of the following:

(a) An equivalent gate count of more than 5,000 (2 input gates); or

(b) A toggle frequency exceeding 100 MHz;

9. Neural network integrated circuits;

10. Custom integrated circuits, for which either the function is unknown, or the control status of the equipment in which the integrated circuit will be used is unknown, having any of the following:

(a) More than 144 terminals;

(b) A typical basic gate propagation delay time of less than 0·4 ns; or

(c) An operating frequency exceeding 3 GHz;

11. Digital integrated circuits, other than those described in sub—heads a.3. to a.10. of this entry, based upon any compound semiconductor and having either of the following:

(a) An equivalent gate count of more than 300 (2 input gates); or

(b) A toggle frequency exceeding 1·2 GHz;

(b) Microwave or millimetre wave devices:

(1) Electronic vacuum tubes and cathodes, as follows:

Notes:

(1) For frequency agile tubes, see entry ML11 in Group 1 ofPart III of this Schedule.

(2) Sub—head b.1. of this entry does not specify tubes designed or rated to operate in the Standard Civil Telecommunications Bands at frequencies not exceeding 31 GHz.

(a) Travelling wave tubes, pulsed or continuous wave, as follows:

(1) Operating at frequencies higher than 31 GHz;

(2) Having a cathode heater element with a turn on time to rated RF power of less than 3 seconds;

(3) Coupled cavity tubes, or derivatives thereof;

(4) Helix tubes, or derivatives thereof, with any of the following:

(a) (1) An instantaneous bandwidth of half an octave or more; and

(2) The product of the rated average output power (expressed in kW) and the maximum operating frequency (expressed in GHz) of more than 0·2;

(b) (1) An instantaneous bandwidth of less than half an octave; and

(2) The product of the rated average output power (expressed in kW) and the maximum operating frequency (expressed in GHz) of more than 0·4; or

(c) Space qualified;

(b) Crossed—field amplifier tubes with a gain of more than 17 dB;

(c) Impregnated cathodes for electronic tubes, with either of the following:

(1) Having a turn on time to rated emission of less than 3 seconds; or

(2) Producing a continuous emission current density at rated operating conditions exceeding 5 A/cm^2;

2. Microwave integrated circuits or modules containing monolithic integrated circuits operating at frequencies exceeding 3 GHz;

Note: Sub—head b.2. of this entry does not specify circuits or modules for equipment designed or rated to operate in the Standard Civil Telecommunications Bands at frequencies not exceeding 31 GHz.

3. Microwave transistors rated for operation at frequencies exceeding 31 GHz;

4. Microwave solid state amplifiers, as follows:

(a) Operating at frequencies exceeding 10·5 GHz and having an instantaneous bandwidth of more than half an octave;

(b) Operating at frequencies exceeding 31 GHz;

Note: Sub—head b.4. of this entry does not specify amplifiers:

(1) Specially designed for medical applications;

(2) Specially designed for use in simple educational devices; or

(3) Having an output power of no more than 10 W and specially designed for:

(a) Industrial or civilian intrusion, detection and alarm systems;

(b) Traffic or industrial movement control and counting systems; or

(c) Systems for the detection of environmental pollution of air or water.

(5) Electronically or magnetically tunable band—pass or band—stop filters having more than 5 tunable resonators capable of tuning across a 1.5:1 frequency band (fmax;/f') in less than 10 microseconds with:

(a) A band—pass bandwidth of more than 0·5% of centre frequency; or

(b) A band—stop bandwidth of less than 0·5% of centre frequency;

(6) Microwave assemblies capable of operating at frequencies exceeding 31 GHz;

(7) Flexible waveguides designed for use at frequencies exceeding 40 GHz;

(c) Acoustic wave devices, as follows, and specially designed components therefor:

(1) Surface acoustic wave and surface skimming (shallow bulk) acoustic wave devices (i.e., signal processing devices employing elastic waves in materials), having either of the following:

Note: Sub—head c.1. of this entry does not specify devices specially designed for home electronics or entertainment.

(a) A carrier frequency exceeding 1 GHz; or

(b) A carrier frequency of 1 GHz or less, and:

(1) A frequency side—lobe rejection exceeding 55 dB;

(2) A product of the maximum delay time and the bandwidth (time in microseconds and bandwidth in MHz) of more than 100; or

(3) A dispersive delay of more than 10 microseconds;

2. Bulk (volume) acoustic wave devices (i.e., signal processing devices employing elastic waves) which permit direct processing of signals at frequencies exceeding 1 GHz;

3. Acoustic—optic signal processing devices employing interaction between acoustic waves (bulk wave or surface wave) and light waves which permit the direct processing of signals or images, including spectral analysis, correlation or convolution;

Note: Sub—head c.3. of this entry does not specify devices specially designed for civil television, video or AM and FM broadcasting equipment.

(d) Electronic devices or circuits containing components, manufactured from superconductive materials specially designed for operation at temperatures below the critical temperature of at least one of the superconductive constituents, with any of the following:

(1) Electromagnetic amplification:

(a) At frequencies equal to or less than 31GHz with a noise figure of less than 0·5dB; or

(b) At frequencies exceeding 31GHz;

(2) Current switching for digital circuits using superconductive gates with aproduct of delay time per gate (in seconds) and power dissipation per gate(in watts) of less than 10^{14}minus; J; or

(3) Frequency selection at all frequencies using resonant circuits with Q—values exceeding 10,000;

(e) High energy devices, as follows:

(1) Batteries, as follows:

Note: Sub—head c.1. of this entry does not specify batteries with volumes equal to or less than 26cm^3 (e.g.,standard C—cells or UM—2 batteries).

(a) Primary cells and batteries having an energy density exceeding 350Wh/kg and rated for operation in the temperature range from below 243K (−30°C) to above 343K (70°C);

(b) Rechargeable cells and batteries having an energy density exceeding150Wh/kg after 75 charge/discharge cycles at a discharge current equal toC/5 hours (C being the nominal capacity in ampere hours) when operating in the temperature range from below 253K (−20°C) to above 333K (60°C);

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

(c) Space qualified and radiation hardened photovoltaic arrays with a specific power exceeding 160W/m^2 at an operating temperature of 301K (28°C) under a tungsten illumination of 1kW/m^2 at 2,800K (2,527°C);

2. High energy storage capacitors, as follows(**24**):

(a) Capacitors with a repetition rate of less than 10Hz (single shot capacitors) having all of the following:

(1) A voltage rating equal to or more than 5kV;

(2) An energy density equal to or more than 250J/kg; and

(3) A total energy equal to or more than 25kJ;

(b) Capacitors with a repetition rate of 10Hz or more (repetition rated capacitors) having all of the following:

(**24**) See also entry 3A201.a.

(1) A voltage rating equal to or more than 5kV;

(2) An energy density equal to or more than 50J/kg;

(3) A total energy equal to or more than 100J; and

(4) A charge/discharge cycle life equal to or more than 10,000;

3. Superconductive electromagnets or solenoids specially designed to be fully charged or discharged in less than one minute, having all of the following(**25**):

(a) Maximum energy delivered during the discharge divided by the duration of the discharge of more than 500kJ per minute;

(b) Inner diameter of the current carrying windings of more than 250mm; and

(c) Rated for a magnetic induction of more than 8T or overall current density in the winding of more than 300A/mm^2;

Note: Sub—head e.3. of this entry does not specify superconductive electromagnets or solenoids specially designed for Magnetic Resonance Imaging (MRI) medical equipment.

4. Circuits or systems for electromagnetic energy storage, containing components manufactured from superconductive materials specially designed for operation at temperatures below the critical temperature of at least one of their superconductive constituents, having all of the following:

(a) Resonant operating frequencies exceeding 1MHz;

(b) A stored energy density of 1MJ/m^3 or more; and

(c) A discharge time of less than 1ms;

5. Flash discharge type X—ray systems, including tubes, having all of the following(**26**):

(a) A peak power exceeding 500MW;

(b) An output voltage exceeding 500kV; and

(c) A pulse width of less than 0·2 microsecond;

(e) Rotary input type shaft absolute position encoders having either of the following:

(1) A resolution of better than 1 part in 265,000 (18 bit resolution) of full scale; or

(2) An accuracy better than ±2·5 seconds of arc.

3A002

General purpose electronic equipment:

(a) Recording equipment, as follows, and specially designed test tape therefor:

1. Analogue instrumentation magnetic tape recorders, including those permitting the recording of digital signals (e.g.,using a high density digital recording (HDDR) module), having any of the following:

a. A bandwidth exceeding 4MHz per electronic channel or track;

b. A bandwidth exceeding 2MHz per electronic channel or track and having more than 42 tracks; or

c. A time displacement (base) error, measured in accordance with applicable Inter Range Instrumentation Group (IRIG) or Electronic Industries Association (EIA) documents, of less than ±0·1 microsecond;

(**25**) See also entry 3A201.b.
(**26**) See also entry 3A201.c.

2. Digital video magnetic tape recorders having a maximum digital interface transfer rate exceeding 180Mbit/s, except: those specially designed for television recording as standardized or recommended by the International Radio Consultative Committee (CCIR) or the International Technical Commission (IEC) for civil television applications;
3. Digital instrumentation magnetic tape data recorders having any of the following characteristics:
    a. A maximum digital interface transfer rate exceeding 60Mbit/s and employing helical scan techniques;
    b. A maximum digital interface transfer rate exceeding 120Mbit/s and employing fixed head techniques; or
    c. Space qualified;
    d. Note: Sub—head a.3. of this entry does not specify analogue magnetic tape recorders equipped with HDDR conversion electronics and configured to record only digital data.
4. Equipment, with a maximum digital interface transfer rate exceeding 60Mbit/s, designed to convert digital video magnetic tape recorders for use as digital instrumentation data recorders;

(b) Frequency synthesiser electronic assemblies having a frequency switching time from one selected frequency to another of less than 1ms;

(c) Signal analysers, as follows:
1. Capable of analysing frequencies exceeding 31GHz;
2. Dynamic signal analysers with a real—time bandwidth exceeding 25·6kHz;

   except:

   Those using only constant percentage bandwidth filters (also known as octave or fractional octave filters);

(d) Frequency synthesised signal generators producing output frequencies, the accuracy and short term and long term stability of which are controlled, derived from or disciplined by the internal master frequency, and having any of the following:
1. A maximum synthesised frequency exceeding 31GHz;
2. A frequency switching time from one selected frequency to another of less than 1ms; or
3. A single sideband (SSB) phase noise better than $-(126 + 20 \log_{10}F - 20 \log_{10}f)$ in dBc/Hz, where F is the off—set from the operating frequency in Hz and f is the operating frequency in MHz;

   Note: Head d. of this entry does not specify equipment in which the output frequency is either produced by the addition or subtraction of two or more crystal oscillator frequencies, or by an addition or subtraction followed by a multiplication of the result.

(e) Network analysers with a maximum operating frequency exceeding 31GHz;

Note: Head e. of this entry does not specify swept frequency network analysers with a maximum operating frequency not exceeding 40GHz and which do not contain a data bus for remote control interfacing.

(f) Microwave test receivers with both of the following:
1. A maximum operating frequency exceeding 31GHz; and

2. Capable of measuring amplitude and phase simultaneously;

(g) Atomic frequency standards having either of the following characteristics:

1. Long term stability (aging) less (better) than 1 x 10^{11}−/month; or

   Note: Sub—head g.1. of this entry does not specify non—space qualified rubidium standards.

2. Space qualified;

(h) Emulators for microcircuits specified in sub—heads a.3. or a.9. of entry 3A001;

Note: Head h. of this entry does not specify emulators designed for a family which contains at least one device not specified in sub—heads a.3. or a.9. of entry 3A001.

3A101

Electronic devices and components, other than those specified in entry 3A001, as follows:

(a) Analogue—to—digital converters, usable in missiles, designed to meet military specifications for ruggedized equipment.

(b) Radiographic equipment, as follows:

1. Equipment capable of delivering electromagnetic radiation produced by bremsstrahlung from accelerated electrons of 2MeV or greater; or

2. Equipment using radioactive sources of 1MeV or greater.

   Note: Head b. of this entry does not specify equipment specially designed for medical purposes.

3A201

Electronic components, other than those specified in entry 3A001, as follows:

(a) Capacitors with the following characteristics:

1. Voltage rating greater than 1·4kV, energy storage greater than 10J, capacitance greater than 0·5μF and series inductance less than 50nH; or

2. Voltage rating greater than 750V, capacitance greater than 0·25μF and series inductance less than 10nH;

(b) Superconducting solenoidal electromagnets with all of the following characteristics:

1. Capable of creating magnetic fields of more than 2 teslas (20 kilogauss);

2. With an L/D ratio (length divided by inner diameter) greater than 2;

3. With an inner diameter of more than 300mm; and

4. With a magnetic field uniform to better than 1% over the central 50% of the inner volume.

   Note: Head b. of this entry does not specify magnets specially designed for and exported as parts of medical nuclear magnetic resonance (NMR) imaging systems. It is understood that, for the purposes of this entry, the wording `as part of' does not necessarily mean physical part in the same shipment. Separate shipments from different sources are allowed, provided the related export documents clearly specify the `part of' relationship.

(c) Flash X—ray generators or pulsed electron accelerators with peak energy of 500keV or greater, as follows; except:

Accelerators that are component parts of devices designed for purposes other than electron beam or X—ray radiation (electron microscopy, for example) and those designed for medical purposes:

1. Having an accelerator peak electron energy of 500 keV or greater but less than 25 MeV and with a figure of merit (K) of 0·25 or greater, where K is defined as:

   $K = 1{\cdot}7 \times 10^{3} V^{2{\cdot}65} Q;$

   where

   V is the peak electron energy in million electron volts and Q is the total accelerated charge in coulombs if the accelerator beam pulse duration is less than or equal to 1 microsecond; if the accelerator beam pulse(cont.)duration is greater than 1 microsecond, Q is the maximum accelerated charge in 1 microsecond [Q equals the integral of i with respect to t, over the lesser of1 microsecond or the time duration of the beam pulse (Q=[integral] idt), where i is beam current in amperes and t is time in seconds]; or

2. Having an accelerator peak electron energy of 25 MeV or greater and a peak power greater than 50MW. [Peak power=(peak potential in volts)×(peak beam current in amperes)]

Technical Notes:

(a) Time duration of the beam pulse—In machines, based on microwave accelerating cavities, the time duration of the beam pulse is the lesser of1 microsecond or the duration of the bunched beam packet resulting from one microwave modulator pulse.

(b) Peak beam current—In machines based on microwave accelerating cavities, the peak beam current is the average current in the time duration of a bunched beam packet.

3A202

Oscilloscopes and transient recorders as follows; and specially designed components therefor:

(a) Non—modular analogue oscilloscopes having a bandwidth of 1GHz or greater;

(b) Modular analogue oscilloscope systems having either of the following characteristics:

1. A mainframe with a bandwidth of 1GHz or greater; or
2. Plug—in modules with an individual bandwidth of 4GHz or greater;

(c) Analogue sampling oscilloscopes for the analysis of recurring phenomena with an effective bandwidth greater than 4GHz;

(d) Digital oscilloscopes and transient recorders, using analogue—to—digital conversion techniques, capable of storing transients by sequentially sampling single—shot inputs at successive intervals of less than 1ns (greater than 1 giga—sample per second), digitizing to 8 bits or greater resolution and storing 256 or more samples.

Note: Specially designed components specified in this entry are the following, for analogue oscilloscopes:

1. Plug—in units;
2. External amplifiers;
3. Pre—amplifiers;
4. Sampling devices;
5. Cathode ray tubes.

Technical Note: For the purposes of this entry, the term `bandwidth' means the band of frequencies over which the deflection on the cathode ray tube does not fall below 70·7% of that at the maximum point measured with a constant input voltage to the oscilloscope amplifier.

3A225

Frequency changers (also known as converters or inverters) or generators, other than those specified in entry B10.b.2.k. of Group 2 of Part III of this Schedule, having all of the following characteristics:

(a) A multiphase output capable of providing a power of 40W or more;

(b) Capable of operating in the frequency range between 600 and 2,000Hz;

(c) Total harmonic distortion below 10%; and

(d) Frequency control better than 0·1%.

3A226

Direct current high—power supplies capable of continuously producing, over a time period of 8 hours, 100V or greater with current output of 500A or greater and with current or voltage regulation better than 0·1%.

3A227

High—voltage direct current power supplies capable of continuously producing, over a time period of 8 hours, 20,000V or greater with current output of 1A or greater and with current or voltage regulation better than 0·1%.

3A228

Switching devices, as follows:

(a) Cold—cathode tubes (including gas krytron tubes and vacuum sprytron tubes), whether gas filled or not, operating similarly to a spark gap, containing three or more electrodes, and having all of the following characteristics:

(1) Anode peak voltage rating of 2,500V or more;

(2) Anode peak current rating of 100A or more; and

(3) Anode delay time of 10 microsecond or less;

(b) Triggered spark—gaps having an anode delay time of 15 microsecond or less and rated for a peak current of 500A or more;

(c) Modules or assemblies with a fast switching function having all of the following characteristics:

1. Anode peak voltage rating greater than 2,000V;

2. Anode peak current rating of 500A or more; and

3. Turn—on time of 1 microsecond or less.

3A229

Firing sets and equivalent high—current pulse generators (for controlled detonators), as follows(**27**):

(a) Explosive detonator firing sets designed to drive multiple controlled detonators specified in entry 3A232;

(**27**) See also Group 1 of Part III of this Schedule.

(b) Modular electrical pulse generators (pulsers) designed for portable, mobile or ruggedized use (including xenon flash—lamp drivers) having all the following characteristics:

1. Capable of delivering their energy in less than 15 microsecond;
2. Having an output greater than 100A;
3. Having a rise time of less than 10 microsecond into loads of less than 40ohms (rise time is the time interval from 10% to 90% current amplitude when driving a resistive load);
4. Enclosed in a dust—tight enclosure;
5. No dimension greater than 254mm;
6. Weight less than 25kg; and
7. Specified for use over an extended temperature range (223K [−50°C] to 373K [100°C]) or specified as suitable for aerospace use.

3A230

High—speed pulse generators with output voltages greater than 6 volts into a less than 55ohm resistive load, and with pulse transition times less than 500 picoseconds.

Technical Note: In this entry, pulse transition time is defined as the time interval between 10% and 90% voltage amplitude.

3A231

Neutron generator systems, including tubes, designed for operation without an external vacuum system and utilizing electrostatic acceleration to induce a tritium—deuterium nuclear reaction.

3A232

Detonators and multipoint initiation systems, as follows(**28**):

(a) Electrically driven explosive detonators, the following:

1. Exploding bridge (EB);
2. Exploding bridge wire (EBW);
3. Slapper;
4. Exploding foil initiators (EFI);

(b) Arrangements using single or multiple detonators designed to nearly simultaneously initiate an explosive surface (over greater than 5,000mm^2) from a single firing signal (with an initiation timing spread over the surface of less than2·5 microseconds).

Note: This entry does not specify detonators using only primary explosives, such as lead azide.

Technical Note: The detonators of concern all utilise a small electrical conductor (bridge, bridge wire or foil) that explosively vapourises when a fast, high—current electrical pulse is passed through it. In nonslapper types, the exploding conductor starts a chemical detonation in a contacting high—explosive material such as PETN (Pentaerythritoltetranitrate). In slapper detonators, the explosive vapourisation of the electrical conductor drives a flyer or slapper across a gap and the impact of the slapper on an explosive starts a chemical detonation. The slapper in some designs is driven by a

(**28**) See also Group 1 of Part III of this Schedule.

magnetic force. The term `exploding foil' detonator may refer to either an EB or a slapper—type detonator. Also, the word `initiator' is sometimes used in place of the word `detonator'.

3A233

Mass spectrometers, other than those specified in entry B20(g) of Group 2 of Part III of this Schedule, capable of measuring ions of 230 atomic mass units or greater and having a resolution of better than 2 parts in 230, as follows; and ion sources therefor:

(a) Inductively coupled plasma mass spectrometers (ICP/MS);

(b) Glow discharge mass spectrometers (GDMS);

(c) Thermal ionization mass spectrometers (TIMS);

(d) Electron bombardment mass spectrometers which have a source chamber constructed from, lined with or plated with materials resistant to UF_6;

(e) Molecular beam mass spectrometers as follows:

1. Which have a source chamber constructed from, lined with or plated with stainless steel or molybdenum and have a cold trap capable of cooling to 193K (−80°C) or less; or

2. Which have a source chamber constructed from, lined with or plated with materials resistant to UF_6; or

(f) Mass spectrometers equipped with a microfluorination ion source designed for use with actinides or actinide fluorides.

3A990

Apparatus or devices, other than those specified in entry PL5006 of Group 1 of Part III of this Schedule or entries 3A229 to 3A232 of this Group, designed for the handling, control, discharging, decoying, jamming, detonation, disruption or detection of explosive devices or improvised explosive devices;

except:

(1) Inspection devices not employing electronic management;

(2) X—ray apparatus or devices, not specified elsewhere in this Group.

Test, Inspection and Production Equipment

3B

3B

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

3B001

Stored programme controlled equipment for epitaxial growth, as follows:

(a) Capable of producing a layer thickness uniform to less than ±2·5% across a distance of 75mm or more;

(b) Metal organic chemical vapour deposition (MOCVD) reactors specially designed for compound semiconductor crystal growth by the chemical reaction between materials specified in entries 3C003 or 3C004;

(c) Molecular beam epitaxial growth equipment using gas sources.

3B002

Stored programme controlled equipment designed for ion implantation, having any of the following:

(a) An accelerating voltage exceeding 200keV;

(b) Specially designed and optimized to operate at an accelerating voltage of less than 10keV;

(c) Direct write capability; or

(d) Capable of high energy oxygen implant into a heated semiconductor material substrate.

3B003

Stored programme controlled anisotropic plasma dry etching equipment, as follows:

(a) With cassette—to—cassette operation and load—locks, and having either of the following:

1. Magnetic confinement; or

2. Electron cyclotron resonance (ECR);

(b) Specially designed for equipment specified in entry 3B006 and having either of the following:

1. Magnetic confinement; or

2. Electron cyclotron resonance (ECR).

3B004

Stored programme controlled plasma enhanced CVD equipment, as follows:

(a) With cassette—to—cassette operation and load—locks, and having either of the following:

1. Magnetic confinement; or

2. Electron cyclotron resonance (ECR);

(b) Specially designed for equipment specified in entry 3B006 and having either of the following:

1. Magnetic confinement; or

2. Electron cyclotron resonance (ECR).

3B005

Stored programme controlled multifunctional focussed ion beam systems specially designed for manufacturing, repairing, physical layout analysis and testing of masks or semiconductor devices, having either of the following:

(a) Target—to—beam position feedback control precision of 0·25 micrometre or finer; or

(b) Digital—to—analogue conversion resolution exceeding 12 bit.

3B006

Stored programme controlled automatic loading multi—chamber central wafer handling systems, having interfaces for wafer input and output, to which more than two pieces of semiconductor processing equipment are to be connected, to form an integrated system in a vacuum environment for sequential multiple wafer processing.

Note: This entry does not specify automatic robotic wafer handling systems not designed to operate in a vacuum environment.

3B007

Stored programme controlled lithography equipment, as follows:

(a) Align and expose step and repeat equipment for wafer processing using photo—optical or X—ray methods, having any of the following:

1. A light source wavelength shorter than 400nm;
2. A numerical aperture more than 0·40; or
3. An overlay accuracy of ±0·20 micrometre (3 sigma) or better;

Note: Head a. of this entry does not specify align and expose step and repeat equipment having all of the following:

1. A light source wavelength of 436nm or more;
2. A numerical aperture 0·38 or less; and
3. An image size diameter 22mm or less.

(b) Equipment specially designed for mask making or semiconductor device processing using deflected focussed electron beam, ion beam or laser beam, with any of the following:

1. A spot size smaller than 0·2 micrometre;
2. Capable of producing a pattern with a feature size of less than 1 micrometre; or
3. An overlay accuracy of better than ±0·20 micrometre (3 sigma).

3B008

Masks or reticles, as follows:

(a) For integrated circuits specified in entry 3A001;

(b) Multi—layer masks with a phase shift layer.

3B009

Stored programme controlled test equipment, specially designed for testing semiconductor devices and unencapsulated dice, as follows:

(a) For testing S—parameters of transistor devices at frequencies exceeding 31GHz;

(b) For testing integrated circuits, and electronic assemblies thereof, and capable of performing functional (truth table) testing at a pattern rate of more than 40MHz;

Note:Head b. of this entry does not specify test equipment specially designed for testing:

1. Electronic assemblies or a class of electronic assemblies for home or entertainment applications;
2. Electronic components, electronic assemblies or integrated circuits not specified in this Group.

(c) For testing microwave integrated circuits at frequencies exceeding 3GHz;

Note: Head c. of this entry does not specify test equipment specially designed for testing microwave integrated circuits for equipment designed or rated to operate in the Standard Civil Telecommunication Bands at frequencies not exceeding 31GHz.

(d) Electron beam systems designed for operation at or below 3keV, or laser beam systems, for the non—contactive probing of powered—up semiconductor devices, with both of the following:

1. Stroboscopic capability with either beam—blanking or detector strobing; and
2. An electron spectrometer for voltage measurement with a resolution of less than 0·5V.

Note:Head d. of this entry does not specify scanning electron microscopes;

except:

when specially designed and instrumented for the non—contactive probing of powered—up semiconductor devices.

Materials

3C

3C001

Hetero—epitaxial materials consisting of a substrate with stacked epitaxially grown multiple layers of:

(a) Silicon;

(b) Germanium; or

(c) III/V compounds of gallium or indium.

Technical Note: III/V compounds are polycrystalline or binary or complex monocrystalline products consisting of elements of groups IIIA and VA of Mendeleyev's perodic classification table (gallium arsenide, gallium—aluminium arsenide, indium phosphide, etc).

3C002

Resist materials, as follows, and substrates coated with controlled resists:

(a) Positive resists with a spectral response optimized for use below 370 nm;

(b) All resists, for use with electron beams or ion beams, with a sensitivity of0·01 microcoulomb/mm^2 or better;

(c) All resists, for use with X—rays, with a sensitivity of 2·5 mJ/mm^2 or better;

(d) All resists optimized for surface imaging technologies, including silyated resists.

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

3C003

Metal—organic compounds of aluminium, gallium or indium, having a purity (metal basis) better than 99·999%.

3C004

Hydrides of phosphorous, arsenic or antimony, having a purity better than 99·999%, even if diluted in neutral gases.

Note: This entry does not specify hydrides containing 20% molar or more of rare gases or hydrogen.

Software

3D

3D001

Software specially designed for the development or production of goods specified inhead b. of entry 3A001 to head h. of entry 3A002 or Sub—category 3B.

3D002

Software specially designed for the use of stored programme controlled equipment specified in sub —category 3B.

3D003

Computer—aided—design (CAD) software for semiconductor devices or integrated circuits, having any of the following:

(a) Design rules or circuit verification rules;

(b) Simulation of the physically laid out circuits; or

(c) Lithographic processing simulators for design.

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

Note: This entry does not specify software specially designed for schematic entry, logic simulation, placing and routing, layout verification or pattern generation tape.

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

3D101

Software specially designed for the use of goods specified in head b. of entry 3A101.

Technology

3E

3E001

Technology required for the development or production of goods specified in sub—categories 3A, 3B or 3C;

Note: This entry does not specify technology for the development or production of:

(a) Microwave transistors operating at frequencies below 31 GHz;

(b) Integrated circuits specified in sub heads a.3. to a.11. of entry 3A001, having both of the following characteristics:

1. Using technology of one micrometre or more, and
2. Not incorporating multi—layer structures.

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

3E002

The export of goods specified in this entry is only prohibited to any destination in any country listed in Schedule 2.

Other technology for the development or production of:

(a) Vacuum microelectronic devices;

(b) Hetero—structure semiconductor devices such as high electron mobility transistors (HEMT), hetero—bipolar transistors (HBT), quantum well or super lattice devices;

(c) Superconductive electronic devices.

3E101

Technology required for the use of goods specified in sub—heads a.1. or a.2. of entry 3A001, entries 3A101 or 3D101.

3E102

Technology required for the development of software specified in entry 3D101.

3E201

Technology required for the use of goods specified in sub—head e.2. of entry 3A001, sub—head e.3. of entry 3A001, sub—head e.5. of entry 3A001, or entries 3A201, 3A202, 3A225 to 3A233.

3E990

Technology required for the use of goods specified in entry 3A990.
Category 4 Computers

Notes:

1. Computers, related equipment or software performing telecommunications or local area network functions must also be evaluated against the performance characteristics of Category 5 (Part 1—Telecommunications).

N.B.:

1. Control units which directly interconnect the buses or channels of central processing units, main storage or disk controllers are not regarded as telecommunications equipment described in Category 5 (Part 1—Telecommunications).

2. Software which provides routing or switching of datagram or fast select packets (i.e., packet by packet route selection) or of software specially designed for packet switching, is specified in Category 5 (Part 1—Telecommunications).

2. Computers, related equipment or software performing cryptographic, cryptanalytic, certifiable multi—level security or certifiable user isolation functions, or which limit electromagnetic compatibility (EMC), must also be evaluated against the performance characteristics in Category 5 (Part 2—Information Security).

Equipment, Assemblies and Components

4A

4A001

Electronic computers and related equipment, as follows, and electronic assemblies and specially designed components therefor(**29**):

(a) Specially designed to have either of the following characteristics:

1. Rated for operation at an ambient temperature below 228 K (−45°C) or above 343 K (70°C); or

   Note: Sub—head a.1. of this entry does not apply to computers specially designed for civil automobile or railway engine applications.

2. Radiation hardened to exceed any of the following specifications:

   a. Total Dose 5×10^5 Rads (Si);

   b. Dose Rate Upset 5×10^8 Rads (Si)/sec; or

   c. Single Event Upset $1\times^{10}-$ Error/bit/day;

   d. Note: For equipment designed or rated for transient ionising radiation, see Group 1 of Part III of this Schedule.

(b) Having characteristics or performing functions exceeding the limits in Category 5 (Part 2 —Information Security).

4A002

Hybrid computers, as follows, and electronic assemblies and specially designed components therefor(**30**):

(a) Containing digital computers specified in entry 4A003;

(b) Containing analogue—to—digital or digital—to—analogue converters having both of the following characteristics:

1. 32 channels or more; and

2. A resolution of 14 bits (plus sign bit) or more with a conversion rate of 200,000 conversions/s or more.

4A003

Digital computers, electronic assemblies, and related equipment therefor, as follows, and specially designed components therefor:

Notes:

1. This entry includes vector processors, array processors, logic processors, and equipment for image enhancement or signal processing.

2. Digital computers or related equipment described in this entry are specified by the entry that refers to other equipment or systems provided:

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

(b) The digital computers or related equipment are not a principal element of the other equipment or systems; and

NB:

(**29**) See also entry 4A101.
(**30**) See also entry 4A102.

(1) The status of signal processing or image enhancement equipment described in head g. of this entry and specially designed for other equipment with functions limited to those required for the other equipment is determined by the status of the other equipment even if it exceeds the principal element criterion.

(2) Digital computers or related equipment for telecommunications equipment, are specified in Category 5 (Part 1—Telecommunications).

(c) The technology for the digital computers and related equipment is specified in sub—category 4E.

3. Digital computers or related equipment are not specified in entry 4A003 provided:

(a) They are essential for medical applications;

(b) The equipment is substantially restricted to medical applications by nature of its design and performance;

(c) The equipment does not have user—accessible programmability other than that allowing for insertion of the original or modified programmes supplied by the original manufacturer;

(d) The composite theoretical performance of any digital computer which is not designed or modified but is essential for the medical application, does not exceed 20 million theoretical operations per second (Mtops); and

(e) The technology for the digital computers or related equipment is specified in sub—category 4E.

(a) Designed for combined recognition, understanding and interpretation of image or continuous (connected) speech;

(b) Designed or modified for fault tolerance;

Note: For the purposes of head b. of this entry, digital computers and related equipment are not considered to be designed or modified for fault tolerance if they use:

(1) Error detection or correction algorithms in main storage;

(2) The interconnection of two digital computers so that, if the active central processing unit fails, an idling but mirroring central processing unit can continue the system's functioning;

(3) The interconnection of two central processing units by data channels or by use of shared storage to permit one central processing unit to perform other work until the second central processing unit fails, at which time the first central processing unit takes over in order to continue the system's functioning; or

(4) The synchronisation of two central processing units by software so that one central processing unit recognises when the other central processing unit fails and recovers tasks from the failing unit.

(c) Digital computers having a composite theoretical performance (CTP) exceeding12·5 million theoretical operations per second (Mtops);

(d) Electronic assemblies specially designed or modified to enhance performance by aggregation of computing elements, as follows:

(1) Designed to be capable of aggregation in configurations of 16 or more computing elements; or

(2) Having a sum of maximum data rates on all data channels available for connection to associated processors exceeding 40MBytes/s;

Notes:

(1) Head d. of this entry applies only to electronic assemblies and programmable interconnections not exceeding the limit of head c. of this entry, when shipped as unintegrated electronic assemblies. It does not apply to electronic assemblies inherently limited by nature of their design for use as related equipment specified in heads e. to k. of this entry.

(2) Head d. of this entry does not specify electronic assemblies specially designed for a product or family of products whose maximum configuration does not exceed the limit of head c. of this entry.

(e) Disk drives and solid state storage equipment, as follows:

(1) Magnetic, erasable optical or magneto—optical disk drives with a maximum bit transfer rate exceeding 25Mbit/s;

(2) Solid state storage equipment, other than main storage (also known as solid state disks or RAM disks), with a maximum bit transfer rate exceeding 36Mbit/s;

(f) Input/output control units designed for use with equipment specified in head e. of this entry;

(g) Equipment for signal processing or image enhancement having a composite theoretical performance exceeding 8·5 million theoretical operations per second (Mtops);

(h) Graphics accelerators or graphics coprocessors exceeding a 3—D vector rate of 400,000 or, if supported by 2—D vectors only, a 2—D vector rate of 600,000;

Note: Head h. of this entry does not apply to work stations designed for and limited to:

(1) Graphic arts (e.g.,printing, publishing); and

(2) The display of two—dimensional vectors.

(i) Colour displays or monitors having more than 12 resolvable elements per mm in the direction of the maximum pixel density;

Notes:

(1) Head i. of this entry does not specify displays or monitors not specially designed for electronic computers.

(2) Displays specially designed for Air Traffic Control (ATC) systems are treated as specially designed components for ATC systems under Category 6.

(j) Equipment performing analogue—to—digital or digital—to—analogue conversions exceeding the limits in sub—head a.5. of entry 3A001;

(k) Equipment containing terminal interface equipment exceeding the limits in sub—head b.3. of entry 5A001.

Note: For the purposes of head k. of this entry, terminal interface equipment includes local area network interfaces, modems and other communications interfaces. Local area network interfaces are evaluated as network access controllers.

4A004

Computers, as follows, and specially designed related equipment, electronic assemblies and components therefor:

(a) Systolic array computers;

(b) Neural computers;

(c) Optical computers.

4A101

Analogue computers, digital computers or digital differential analysers, other than those specified in sub—head a.1. of entry 4A001, which are ruggedized and designed or modified for use in systems specified in entries 9A004 or 9A104.

4A102

Hybrid computers specially designed for modelling, simulation or design integration of systems specified in entries 9A004 or 9A104.

Note: This entry only applies when the equipment is supplied with software specified in entry 9D103.

Test, Inspection and Production Equipment

4B

4B001

Equipment specially designed for the application of magnetic coating to non—flexible (rigid) magnetic or magneto—optical media specified in head e. of entry 4A003.

Note: This entry does not specify general purpose sputtering equipment.

4B002

Stored programme controlled equipment specially designed for monitoring, grading, exercising or testing rigid magnetic media specified in head e. of entry 4A003.

4B003

Equipment specially designed for the production or alignment of heads or head/disk assemblies for rigid magnetic and magneto—optical storage specified in head e. of entry 4A003, and electro—mechanical or optical components therefor.

Materials

4C

4C001

Materials specially formulated for and required for the fabrication of head/disk assemblies for magnetic and magneto—optical hard disk drives specified in head e. of entry 4A003.

Software

4D Note: Software for the development, production, or use of equipment described in other Categories is dealt with in the appropriate Category. Software for equipment described in this Category is dealt with herein.

4D001

Software specially designed or modified for the development, production or use of goods specified in entries 4A001 to 4A004, or sub—categories 4B, 4C or 4D.

4D002

Software specially designed or modified to support technology specified in sub—category 4E.

4D003

Specific software, as follows:

(a) Programme proof and validation software using mathematical and analytical techniques and designed or modified for programmes having more than 500,000 source code instructions;

(b) Software allowing the automatic generation of source codes from data acquired on line from external sensors described in these Lists;

(c) Operating system software, software development tools and compilers specially designed for multi—data—stream processing equipment, in source code;

(d) Expert systems or software for expert system inference engines providing both:

1. Time dependent rules; and
2. Primitives to handle the time characteristics of the rules and the facts;

(e) Software having characteristics or performing functions exceeding the limits in Category 5 (Part 2—Information Security);

(f) Operating systems specially designed for real time processing equipment which guarantees a global interrupt latency time of less than 30 microseconds.

Technology

4E

4E001

Technology required, for the development, production or use of goods specified in sub—categories 4A, 4B, 4C or 4D.

4E002

The export of goods specified in this entry is only prohibited to any destination in any country listed in Schedule 2.

(a) Technology for the development or production of goods released in head h. of entry 4A003;

(b) Technology for the development or production of goods designed for multi—data—stream processing;

(c) Technology required for the development or production of magnetic hard disk drives with a maximum bit transfer rate exceeding 11 Mbit/s.

Technical Note to Category 4

Composite Theoretical Performance (CTP)

Abbreviations used in this Technical Note

CE	**computing element** (typically an arithmetic logical unit)
FP	floating point

XP	fixed point
t	execution time
XOR	exclusive OR
CPU	central processing unit
TP	theoretical performance (of a single CE)
CTP	**composite theoretical performance** (multiple CEs)
R	effective calculating rate

Execution time `t' is expressed in microseconds, and CTP is expressed in Mtops (millions of theoretical operations per second). CTP is a measure of computational performance given in millions of theoretical operations per second (Mtops). In calculating the Composite Theoretical Performance (CTP) of a configuration of computing elements (CEs) the following three steps are required:

1. Calculate the effective calculating rate R for each CE;
2. Apply the word length adjustment to this rate, resulting in a Theoretical Performance (TP) for each CE. Select the maximum resulting value of TP;
3. If there is more than one computing element, combine the TPs resulting in a Composite Theoretical Performance for the configuration.

   Note: This aggregation should not be applied to computers connected through a local area network not specified in entry 5A001.

The following table shows the method of calculating the effective calculating rate (R) for each computing element:

For computing elements (CEs) implementing:	Effective calculating rate, R
XP only (R_{xp})	$\frac{1}{3 * (t_{xp\ add})}$ if no add is implemented use: $\frac{1}{(t_{xp\ mult})}$ If neither add nor multiply is implemented use the fastest available arithmetic operation as follows: $\frac{1}{3 * t_{xp}}$ See Notes X & Z
FP only (R_{fp})	Max $\frac{1}{t_{fp\ add}}, \frac{1}{t_{fp\ mult}}$

For computing elements (CEs) implementing:	Effective calculating rate, R
	See Notes X & Y
Both	Calculate both
FP and XP	R_{xp}, R_{fp}
(R)	
For simple logic processors not implementing any of the specified arithmetic operations.	$\frac{1}{3 * t_{log}}$ Where t_{log} is the execution time of the XOR, or for logic hardware not implementing the XOR, the fastest simple logic operation.
For special logic processors not using any of the specified arithmetic or logic operations.	See Notes X & Z $R = R' * WL/64$ Where R' is the number of results per second, WL is the number of bits upon which the logic operation occurs, and 64 is a factor to normalize to a 64 bit operation.

Note X:

For CEs which perform multiple arithmetic operations of a specific type in a single cycle (e.g., two additions per cycle), the execution time t is given by:

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

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

If a single CE has both scalar function and vector function, use larger value.

Note Y:

If no FP add or FP multiply are implemented, but the CE performs FP divide:

$$R_{fp} = \frac{1}{t_{fpdivide}};$$

If the divide is not implemented, the fp reciprocal should be used. If none of the specified instruction is implemented, the effective FP rate is 0.

Note Z:

In simple logic operations, a single instruction performs a single logic manipulation of no more than two operands of given lengths. In complex logic operations, a single instruction performs multiple logic manipulations to produce one or more results from two or more operands. Rates should be calculated for all supported operand lengths, using the fastest executing instruction for each operand length based on:

(1) Register—to—register. Exclude extraordinarily short execution times generated for operations on a predetermined operand or operands (for example, multiplication by 0 or 1). If no register —to—register operations are implemented, continue with 2.

(2) The faster of register—to—memory or memory—to—register operations; if these also do not exist, then continue with 3.

(3) Memory—to—memory. In each case above, use the shortest execution time certified by the manufacturer.

TP for each supported operand length WL

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

$$TP = R * L,$$

where L = (1/3 + WL/96)

Note:

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

This adjustment is not applied to specialized logic processors which do not use XOR instructions. In this case TP = R.

Select the maximum resulting value of TP for:

Each XP—only CE (Rxp;);

Each FP—only CE (Rfp;);

Each combined FP and XP CE (R);

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

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

CTP for CPUs and aggregations of CEs

For a CPU with a single CE,

CTP = TP

(for CEs performing both fixed and floating point operations TP = max (TPfp;, TPxp;))

For aggregations of multiple CEs operating simultaneously:

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

Note 2:A single integrated circuit chip or board assembly may contain multiple CEs.

Note 3:Simultaneous operations are assumed to exist when the computer manufacturer claims concurrent, parallel or simultaneous operation or execution in a manual or brochure for the computer.

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

where

TP_1 is the highest of the TPs, and C_i is a coefficient determined by the strength of the interconnection between CEs, as follows:

For multiple CEs sharing memory:

$$C_2 = C_3 = C_4 . = C_n = 0{\cdot}75$$

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

For multiple CEs not sharing memory, interconnected by one or more data channels:

$$C_i = \frac{8 * S_i}{(WL_i * TP_i)}$$

where

(i = 2, . . ., n)

S_i = sum of the maximum data rates (in units of MByte/sec) for all data channels connected to the ith; CE or CPU,

Note: This does not include channels dedicated to transfers between one individual processor and its most immediate memory or related equipment.

WL_i is the operand length for which TP_i was obtained, and the factor 8 normalizes S_i (measured in bytes per second) and WL (given in bits).

Note: If C_i exceeds 0·75, the formula for CE/CPU sharing direct addressable memory applies (i.e., C_i cannot exceed 0·75).

Category 5Telecommunications and Information Security

Telecommunications

Part 1 Notes:

1. Components, lasers, test and production equipment, materials and software therefor, which are specially designed for telecommunications equipment or systems are described in this Category.

2. Digital computers, related equipment or software, when essential for the operation and support of telecommunications equipment described in this Category, are regarded as specially designed components, provided they are the standard models customarily supplied by the manufacturer. This includes operation, administration, maintenance, engineering or billing computer systems.

Equipment, Assemblies and Components

5A1

5A001

a. Any type of telecommunications equipment having any of the following characteristics, functions or features:

1. Specially designed to withstand transitory electronic effects or electromagnetic pulse arising from a nuclear explosion;
2. Specially hardened to withstand gamma, neutron or ion radiation;
3. Specially designed to operate outside the temperature range from 219K (−54°C) to 397K (124°C);

Note: Sub—heads a.2. and a.3. of this entry do not apply to equipment on board satellites.

b. Telecommunication transmission equipment or systems, and specially designed components and accessories therefor, having any of the following characteristics, functions or features:

c. Note: Telecommunication transmission equipment:

d. Categorised as follows, or combinations thereof:

1. Radio equipment (e.g., transmitters, receivers and transceivers);
2. Line terminating equipment;
3. Intermediate amplifier equipment;
4. Repeater equipment;
5. Regenerator equipment;
6. Translation encoders (transcoders);
7. Multiplex equipment (statistical multiplex included);
8. Modulators/demodulators (modems);
9. Transmultiplex equipment (see CCITT Recommendation G.701);
10. Stored programme controlled digital crossconnection equipment;
11. Gateways and bridges;
12. Media access units; and

e. Designed for use in single or multi—channel communication via:

1. Wire (line);
2. Coaxial cable;
3. Optical fibre cable;
4. Electromagnetic radiation.

1. Employing digital techniques, including digital processing of analogue signals, and designed to operate at a digital transfer rate at the highest multiplex level exceeding 45 Mbit/s or a total digital transfer rate exceeding 90 Mbit/s;

Note: Sub—head b.1. of this entry does not specify equipment specially designed to be integrated and operated in any satellite system for civil use.

2. Being stored programme controlled digital cross connect equipment with a digital transfer rate exceeding 8·5Mbit/s per port;

3. Being equipment containing:

(a) Modems using the bandwidth of one voice channel with a data signalling rate exceeding 9,600bit/s;

Note: Sub—head 3.a. of this entry does not specify dedicated stand—alone facsimile equipment with a data signalling rate not exceeding 14,400bit/s and not specified in entries 5A002, 5B002, 5C002, 5D002 or 5E002 (Part 2—Information Security). In addition, the embedded modem in such equipment must be of the single chip type and it must not be feasible to remove the modem from the dedicated stand—alone equipment.

(b) Communication channel controllers with a digital output having a data signalling rate exceeding 64,000bit/s per channel; or

(c) Network access controllers and their related common medium having a digital transfer rate exceeding 33Mbit/s;

Note: Equipment, not elsewhere specified, containing a network access controller, cannot have any type of telecommunications interface;

except:

Those described in, but not specified in, sub—head b.3. of this entry.

4. Employing a laser and having any of the following characteristics:

(a) A transmission wavelength exceeding 1,000nm;

(b) Employing analogue techniques and having a bandwidth exceeding 45MHz;

(c) Employing coherent optical transmission or coherent optical detection techniques (also called optical heterodyne or homodyne techniques);

(d) Employing wavelength division multiplexing techniques; or

(e) Performing optical amplification;

5. Being radio equipment operating at input or output frequencies exceeding:

(a) 31GHz for satellite—earth station applications;

(b) 26·5GHz for other applications;

Note: Sub—head b.5.b. of this entry does not specify equipment for civil use conforming with an International Telecommunications Union (ITU) allocated band between 26·5 and 31GHz.

6. Being radio equipment:

(a) Employing quadrature—amplitude—modulation (QAM) techniques abovelevel 4 if the total digital transfer rate exceeds 8·5Mbit/s;

(b) Employing quadrature—amplitude—modulation (QAM) techniques above level 16 if the total digital transfer rate is equal to or less than 8·5Mbit/s; or

(c) Employing other digital modulation techniques and having a spectral efficiency exceeding 3bit/sec/Hz;

Note: Sub—head b.6.c. of this entry does not specify equipment specially designed to be integrated and operated in any satellite system for civil use.

7. Being radio equipment operating in the 1·5 to 87·5MHz band and having either of the following characteristics:

(a) (1) Automatically predicting and selecting frequencies and total digital transfer rates per channel to optimize the transmission; and

(2) Incorporating a linear power amplifier configuration having a capability to support multiple signals simultaneously at an output power of 1kW or more in the 1·5 to 30MHz frequency range or 250W or more in the 30 to 87·5MHz frequency range, over an instantaneous bandwidth of one octave or more and with an output harmonic and distortion content of better than −80dB; or

(b) Incorporating adaptive techniques providing more than 15dB suppression of an interfering signal;

8. Being radio equipment employing spread spectrum or frequency agility (frequency hopping) techniques having either of the following characteristics:

(a) User programmable spreading codes; or

(b) A total transmitted bandwidth which is 100 or more times the bandwidth of any one information channel and in excess of 50kHz;

9. Being digitally controlled radio receivers having more than 1,000 channels, which:

(a) Search or scan automatically a part of the electromagnetic spectrum;

(b) Identify the received signals or the type of transmitter; and

(c) Have a frequency switching time of less than 1ms;

10. Providing functions of digital signal processing as follows:

(a) Voice coding at rates of less than 2,400bit/s;

(b) Employing circuitry which incorporates user—accessible programmability of digital signal processing circuits exceeding the limits of head g. of entry 4A003;

1. Being underwater communications systems having any of the following characteristics:

(a) An acoustic carrier frequency outside the range from 20 to 60kHz;

(b) Using an electromagnetic carrier frequency below 30kHz; or

(c) Using electronic beam steering techniques;

(c) Stored programme controlled switching equipment and related signalling systems, and specially designed components and accessories therefor, having any of the following characteristics, functions or features:

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

(1) Common channel signalling;

Note: Signalling systems in which the signalling channel is carried in and refers to no more than 32 multiplexed channels forming a trunk line of no more than 2·1Mbit/s, and in which the signalling information is carried in a fixed, time division multiplexed channel without the use of labelled messages, are not considered to be common channel signalling systems.

(2) Containing Integrated Services Digital Network (ISDN) functions and having either of the following:

(a) Switch—terminal (e.g.,subscriber line) interfaces with a digital transfer rate at the highest multiplex level exceeding 192,000bit/s, including the associated signalling channel (e.g.,2B+D); or

(b) The capability that a signalling message received by a switch on a given channel that is related to a communication on another channel may be passed through to another switch;

Note: Sub—head c.2. of this entry does not preclude:

(1) The evaluation and appropriate actions taken by the receiving switch;

(2) Unrelated user message traffic on a D channel of ISDN.

(3) Multi—level priority and pre—emption for circuit switching;

Note: Sub—head c.3. of this entry does not specify single—level call pre—emption.

(4) Dynamic adaptive routing;

(5) Routing or switching of datagram packets;

(6) Routing or switching of fast select packets;

Note: The restrictions in sub—heads c.5. and c.6. of this entry do not apply to networks using only network access controllers or to network access controllers themselves.

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

(8) Being packet switches, circuit switches and routers with ports or lines exceeding either:

(a) A data signalling rate of 64,000bit/s per channel for a communications channel controller; or

Note: Sub—head c.8.a. of this entry does not preclude the multiplexing over a composite link of communications channels not specified in sub—head c.8.a.

(b) A digital transfer rate of 33Mbit/s for a network access controller and related common medium;

(9) Optical switching;

(10) Employing Asynchronous Transfer Mode (ATM) techniques;

(11) Containing stored programme controlled digital crossconnect equipment with a digital transfer rate exceeding 8·5Mbit/s per port;

(d) Centralized network control having both of the following characteristics:

(1) Receives data from the nodes; and

(2) Processes these data in order to provide control of traffic not requiring operator decisions, thereby performing dynamic adaptive routing;

Note: Head d. of this entry does not preclude control of traffic as a function of predictable statistical traffic conditions.

(e) Optical fibre communication cables, optical fibres and specially designed components and accessories therefor, as follows:

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

(a) Designed for single mode operation; or

(b) For optical fibres, capable of withstanding a Proof Test tensile stress of 2×10^9 N/m^2 or more;

Technical Note: Proof Test: On—line or off—line production screen testing that dynamically applies a prescribed tensile stress over a 0·5 to 3m length of fibre at a running rate of 2 to 5m/s while passing between capstans approximately 150mm in diameter. The ambient temperature is a nominal 293K (20°C) and relative humidity 40%.

(2) Components and accessories specially designed for the optical fibres or cables specified in sub—head e.1. of this entry;

except:

Connectors for use with optical fibres or cables with a repeatable coupling loss of 0·5dB or more;

(3) Optical fibre cables and accessories designed for underwater use (for fibre—optic hull penetrators or connectors, see head c. of entry 8A002);

(f) Phased array antennae, operating above 10·5GHz, containing active elements and distributed components, and designed to permit electronic control of beam shaping and pointing.

Note: Head f. of this entry does not specify landing systems with instruments meeting International Civil Aviation Organisation (ICAO) standards (microwave landing systems (MLS)), published by ICAO in Annex 10 of Volume 1.

5A101

Telemetering and telecontrol equipment usable for missiles.

Note: This entry does not specify equipment specially designed to be used for remote control of model planes, boats or vehicles and having an electric field strength of not more than 200 microvolts per metre at a distance of 500 m.

5A990

The export of goods specified in this entry is only prohibited to any destination in Iran, Iraq or Libya.

Tropospheric scatter communication equipment using analogue or digital modulation techniques.

Test, Inspection and Production Equipment

5B1

5B001

a. Equipment and specially designed components and accessories therefor:

1. Development of equipment, materials, functions or features specified in entries 5A001, 5B001, 5C001, 5D001 or 5E001, including measuring or test equipment;
2. Production of equipment, materials, functions or features specified in entries 5A001, 5B001, 5C001, 5D001 or 5E001, including measuring, test or repair equipment;
3. Use of equipment, materials, functions or features exceeding any of the least stringent control criteria applicable in entries 5A001, 5B001, 5C001, 5D001 or 5E001, including measuring, repair or test equipment;

   Note: Head a. of this entry does not specify optical fibres and optical fibre preform characterisation equipment not using semiconductor lasers.

b. Other equipment as follows:

1. Bit error rate (BER) test equipment designed or modified to test the equipment specified in sub—head b.1. of entry 5A001;
2. Data communication protocol analysers, testers and simulators for functions specified in sub—head b.1. of entry 5A001;
3. Note: Data communication protocol analysers, testers and simulators for functions specified elsewhere in Category 5, are determined by head a. of this entry.
4. Stand alone stored programme controlled radio transmission media simulators/channel estimators specially designed for testing equipment specified in sub—head b.5. of entry 5A001.

Materials

5C1

5C001

Preforms of glass or of any other material optimized for the manufacture of optical fibres specified in head e. of entry 5A001.

Software

5D1

5D001

a. Software specially designed or modified for the development, production or use of goods specified in entries 5A001, 5B001, 5C001;

b. Software specially designed or modified to support technology specified in entry 5E001;

c. Specific software as follows:

1. Generic software, other than in machine—executable form, specially designed or modified for the use of stored programme controlled digital switching equipment or systems;

2. Software, other than in machine—executable form, specially designed or modified for the use of digital cellular radio equipment or systems;

3. Software specially designed or modified to provide characteristics, functions or features of equipment specified in entries 5A001 or 5B001;

4. Software which provides the capability of recovering source code of telecommunications software specified in this Category;

5. Software specially designed for the development or production of software specified in entry 5D001.

(For software for signal processing see also sub—Categories 4D and 6D)

Technology

5E1

5E001

The export of goods specified in this entry is only prohibited to any destination in any country listed in Schedule 2.

(a) Technology required for the development, production or use (excluding operation) of goods specified in entries 5A001, 5B001, 5C001 or 5D001;

(b) Specific technologies, as follows:

1. Required technology for the development or production of telecommunications equipment specially designed to be used on board satellites;

2. Technology for the development or use of laser communication techniques with the capability of automatically acquiring and tracking signals and maintaining communications through exoatmosphere or sub—surface (water) media;

3. Technology for the processing and application of coatings to optical fibre specially designed to make it suitable for underwater use;

4. Technology for the development or production of equipment employing Synchronous Digital Hierarchy (SDH) or Synchronous Optical Network (SONET) techniques;

5. Technology for the development or production of switch fabric exceeding 64,000bit/s per information channel other than for digital cross connect integrated in the switch;

6. Technology for the development or production of centralized network control;

7. Technology for the development or production of digital cellular radio systems;

8. Technology for the development or production of Integrated Services Digital Network (ISDN).

5E101

Technology required for the development, production or use of goods specified in entry 5A101.

5E990

The export of goods specified in this entry is only prohibited to any destination in Iran, Iraq or Libya.

Technology required for the development, production or use of goods specified in entry 5A990.

Information Security

Part 2— Note: Information security equipment, software, systems, application specific electronic assemblies, modules, integrated circuits, components or functions are defined in this Category even if they are components or electronic assemblies of other equipment.

Equipment, Assemblies and Components

5A2

5A002

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

(a) Designed or modified to use cryptography employing digital techniques to ensure information security;

(b) Designed or modified to perform cryptanalytic functions;

(c) Designed or modified to use cryptography employing analogue techniques to ensure information security;

except:

1. Equipment using fixed band scrambling not exceeding 8 bands and in which the transpositions change not more frequently than once every second;
2. Equipment using fixed band scrambling exceeding 8 bands and in which the transpositions change not more frequently than once every ten seconds;
3. Equipment using fixed frequency inversion and in which the transpositions change not more frequently than once every second;
4. Facsimile equipment;
5. Restricted audience broadcast equipment;
6. Civil television equipment;

(d) Designed or modified to suppress the compromising emanations of information—bearing signals;

Note: Head d. of this entry does not specify equipment specially designed to suppress emanations for health or safety reasons.

(e) Designed or modified to use cryptographic techniques to generate the spreading code for spread spectrum or the hopping code for frequency agility systems;

(f) Designed or modified to provide certified or certifiable multilevel security or user isolation at a level exceeding Class B2 of the Trusted Computer System Evaluation Criteria (TCSEC);

(g) Communications cable systems designed or modified using mechanical, electrical or electronic means to detect surreptitious intrusion.

Note: This entry does not specify:

a. Personalised smart cards using cryptography restricted for use only in equipment or systems excluded from control under sub—heads c.1. to c.6. of this entry, or heads b. to e. of this Note;

b. Equipment containing fixed data compression or coding techniques;

c. Receiving equipment for radio broadcast, pay television or similar restricted audience television of the consumer type, without digital encryption and where digital decryption is limited to the video, audio or management functions;

d. Portable (personal) or mobile radiotelephones for civil use, e.g., for use with commercial civil cellular radiocommunications systems, containing encryption, when accompanying their users;

e. Decryption functions specially designed to allow the execution of copy—protected software, provided the decryption functions are not user—accessible.

Test, Inspection and Production Equipment

5B2

5B002

a. Equipment specially designed for:

1. The development of equipment or functions specified in entries 5A002, 5B002, 5D002 or 5E002, including measuring or test equipment;

2. The production of equipment or functions specified in entries 5A002, 5B002, 5D002 or 5E002, including measuring, test, repair or production equipment;

b. Measuring equipment specially designed to evaluate and validate the information security functions specified in entries 5A002 or 5D002.

Materials

5C2 None.

Software

5D2

5D002

a. Software specially designed or modified for the development, production or use of equipment or software specified in entries 5A002, 5B002 or 5D002;

b. Software specially designed or modified to support technology specified in entry 5E002;

c. Specific software as follows:

1. Software having the characteristics, or performing or simulating the functions of the equipment specified in entries 5A002 or 5B002;

2. Software to certify software specified in sub—head c.1. of this entry;

3. Software designed or modified to protect against malicious computer damage, e.g., viruses.

Note: This entry does not specify:

a. Software required for the use of equipment described in the Note to 5A002;

b. Software providing any of the functions of equipment described in the Note to 5A002.

Technology

5E2

5E002

Technology required for the development, production or use of goods specified in entries 5A002, 5B002 or 5D002.
Category 6Sensors and Lasers

Equipment, Assemblies and Components

6A

Acoustics

6A1

6A001

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

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

1. Note: Sub—head a.1. of this entry does not specify depth sounders operating vertically below the apparatus, not including a scanning function exceeding ±10°, and limited to measuring the depth of water, the distance of submerged or buried objects or fish finding.

b. Wide—swath bathymetric survey systems for sea bed topographic mapping:

1. Designed:

a. To take measurements at an angle exceeding 10° from the vertical; and

b. To measure depths exceeding 600m below the water surface; and

2. Designed:

a. To incorporate multiple beams any of which is less than 2°; or

b. To provide data accuracies of better than 0·5% of water depth across the swath averaged over the individual measurements within the swath;

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

1. A transmitting frequency below 10kHz;

2. Sound pressure level exceeding 224dB (reference 1 micropascal at 1m) for equipment with an operating frequency in the band from 10kHz to 24kHz inclusive;

3. Sound pressure level exceeding 235dB (reference 1 micropascal at 1m) for equipment with an operating frequency in the band between 24kHz and 30kHz;

4. Forming beams of less than 1° on any axis and having an operating frequency of less than 100kHz;

5. Designed to withstand pressure during normal operation at depths exceeding 1,000m and having transducers:

a. Dynamically compensated for pressure; or

b. Incorporating other than lead zirconate titanate as the transduction element; or

6. Designed to measure distances to objects at ranges exceeding 5,120m;

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

e. Note: The status of acoustic projectors, including transducers, specially designed for other equipment is determined by the entry which refers to the other equipment.

1. An instantaneous radiated acoustic power density exceeding 0·01mW/mm^2/Hz for devices operating at frequencies below 10kHz;

2. A continuously radiated acoustic power density exceeding 0·001mW/mm^2/Hz for devices operating at frequencies below 10kHz;

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

4. Designed to withstand pressure during normal operation at depths exceeding 1,000m; or

5. Side—lobe suppression exceeding 22dB;

Note: Sub—head a.1.c. of this entry does not specify electronic sources which direct the sound vertically only, or mechanical (e.g., air gun or vapour—shock gun) or chemical (e.g., explosive) sources.

f. Acoustic systems, equipment or specially designed components for determining the position of surface vessels or underwater vehicles designed:

Note: Sub—head a.1.d. of this entry includes equipment using coherent signal processing between two or more beacons and the hydrophone unit carried by the surface vessel or underwater vehicle, or capable of automatically correcting speed—of—sound propagation errors for calculation of a point.

1. To operate at a range exceeding 1,000m with a positioning accuracy of less than 10mrms (root mean square) when measured at a range of 1,000m; or

2. To withstand pressure at depths exceeding 1,000m;

2. Passive (receiving, whether or not related in normal application to separate active equipment) systems, equipment or specially designed components therefor, as follows:

(a) Hydrophones (transducers) with any of the following characteristics:

(1) Incorporating continuous flexible sensors or assemblies of discrete sensor elements with either a diameter or length less than 20mm and with a separation between elements of less than 20mm;

(2) Having any of the following sensing elements:

(a) Optical fibres;

(b) Piezoelectric polymers; or

(c) Flexible piezoelectric ceramic materials;

(3) Hydrophone sensitivity better than −180dB at any depth with no acceleration compensation;

(4) When designed to operate at depths not exceeding 35m, hydrophone sensitivity better than−186dB with acceleration compensation;

(5) When designed for normal operation at depths exceeding 35m, hydrophone sensitivity better than −192dB with acceleration compensation;

(6) When designed for normal operation at depths exceeding 100m, hydrophone sensitivity better than −204dB; or

(7) Designed for operation at depths exceeding 1,000m;

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

(b) Towed acoustic hydrophone arrays with:

(1) Hydrophone group spacing of less than 12·5m;

(2) Hydrophone group spacing of 12·5m to less than 25m and designed or able to be modified to operate at depths exceeding 35m; or

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

(3) Hydrophone group spacing of 25m or more and designed to operate at depths exceeding 100m;

(4) Heading sensors:

(a) Having an accuracy of better than ±0·5°;

(b) Incorporated within the array hosing and designed or able to be modified to operate at depths exceeding 35m; or

Technical Note: `Able to be modified' in sub—head a.2.b.4.b. of this entry means having an adjustable or removable depth sensing device.

(c) Mounted external to the array hosing and having a sensor unit capable of operating with 360° roll at depths exceeding 35m;

(5) Non—metallic strength members or longitudinally reinforced array hoses;

(6) An assembled array of less than 40mm in diameter;

(7) Multiflexed hydrophone group signals; or

(8) Hydrophone characteristics specified in sub—head a.2.a. of this entry;

(c) Processing equipment, specially designed for towed acoustic hydrophone arrays, with either of the following:

(1) A Fast Fourier or other transform of 1,024 or more complex points in less than 20ms with no user—accessible programmability; or

(2) Time or frequency domain processing and correlation, including spectral analysis, digital filtering and beamforming using Fast Fourier or other transforms or processes with user—accessible programmability;

(b) Terrestrial geophones capable of conversion for use in marine systems, equipment or specially designed components specified in sub—head a.2.a. of this entry;

(c) Correlation—velocity sonar log equipment designed to measure the horizontal speed of the equipment carrier relative to the sea bed at distances between the carrier and the sea bed exceeding 500m.

6A002

Optical sensors

(a) Optical detectors, as follows(**31**):

Note: Head (a) of this entry does not specify germanium or silicon photodevices.

1. Space—qualified single—element or focal plane array (linear or two dimensional) elements having any of the following:

(a) 1. A peak response at a wavelength shorter than 300nm; and

2. A response of less than 0·1% relative to the peak response at a wavelength exceeding 400nm;

(b) 1. A peak response in the wavelength range exceeding 900nm but not exceeding 1,200nm; and

2. A response time constant of 95ns or less; or

(c) A peak response in the wavelength range exceeding 1,200nm but not exceeding 30,000nm;

2. Image intensifier tubes and specially designed components therefor, as follows:

(a) Image intensifier tubes having all of the following:

(1) A peak response in the wavelength range exceeding 400nm but not exceeding 1,050nm;

(2) A microchannel plate for electron image amplification with a hole pitch (centre—to—centre spacing) of less than 25 micrometres; and

(3) (a) An S—20, S—25 or multialkali photocathode; or

(b) A GaAs or GaInAs photocathode;

(b) Specially designed components, as follows:

(1) Fibre optic image inverters;

(2) Microchannel plates having both of the following characteristics:

(a) 15,000 or more hollow tubes per plate; and

(b) Hole pitch (centre—to—centre spacing) of less than 25 micrometres;

(3) GaAs or GaInAs photocathodes;

3. Non—space—qualified linear or two dimensional focal plane arrays, having any of the following:

Notes:

(1) Sub—head a.3. of this entry includes photoconductive arrays and photovoltaic arrays.

(2) This sub—head does not specify silicon focal plane arrays, multi—element (not to exceed 16 elements) encapsulated photoconductive cells or pyroelectric detectors using any of the following:

(a) Lead sulphide;

(b) Triglycine sulphate and variants;

(c) Lead—lanthanum—zirconium titanate and variants;

(**31**) See also entry 6A102.

(d) Lithium tantalate;

(e) Polyvinylidene fluoride and variants;

(f) Strontium barium niobate and variants; or

(g) Lead selenide.

(a) (1) Individual elements with a peak response within the wavelength range exceeding 900 nm but not exceeding 1,050 nm; and

(2) A response time constant of less than 0·5 ns;

(b) (1) Individual elements with a peak response in the wavelength range exceeding 1,050 nm but not exceeding 1,200 nm; and

(2) A response time constant of 95 ns or less; or

(c) Individual elements with a peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm;

4. Non—space—qualified single—element or non—focal—plane multi—element semiconductor photodiodes or phototransistors having both of the following:

(a) A peak response at a wavelength exceeding 1,200 nm; and

(b) A response time constant of 0·5 ns or less;

(b) Multispectral imaging sensors designed for remote sensing applications, having either of the following characteristics–

(1) An Instantaneous—Field—Of—View (IFOV) of less than 200 microradians; or

(2) Specified for operation in the wavelength range exceeding 400 nm but not exceeding 30,000 nm; and

(a) Providing output imaging data in digital format; and

(b) (1) Space—qualified; or

(2) Designed for airborne operation and using other than silicon detectors;

(c) Direct view imaging equipment operating in the visible or infrared spectrum, incorporating either of the following:

(1) Image intensifier tubes specified in sub—head a.2. of this entry; or

(2) Focal plane arrays specified in sub—head a.3. of this entry;

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

Note: Head c. of this entry does not specify the following equipment incorporating other than GaAs or GaInAs photocathodes:

(a) Industrial or civilian intrusion alarm, traffic or industrial movement control or counting systems;

(b) Medical equipment;

(c) Industrial equipment used for inspection, sorting or analysis of the properties of materials;

(d) Flame detectors for industrial furnaces;

(e) Equipment specially designed for laboratory use.

(d) Special support components for optical sensors, as follows:

(1) Space—qualified cryocoolers;

(2) Non—space—qualified cryocoolers, as follows:

(a) Closed cycle with a specified Mean—Time—To—Failure (MTTF), or Mean—Time—Between—Failures (MTBF), exceeding 2,500 hours;

(b) Joule—Thomson (JT) self—regulating minicoolers with bore (outside) diameters of less than 8 mm;

(3) Optical sensing fibres:

(a) Specially fabricated either compositionally or structurally, or modified by coating, to be acoustically, thermally, inertially, electromagnetically or nuclear radiation sensitive; or

(b) Modified structurally to have a beat length of less than 50 mm (high birefringence).

6A003

Cameras(**32**)

(a) Instrumentation cameras, as follows:

1. High—speed cinema recording cameras using any film format from 8 mm to 16 mm inclusive, in which the film is continuously advanced throughout the recording period, and that are capable of recording at framing rates exceeding 13,150 frames per second;

   Note: This sub—head does not specify cinema recording cameras for normal civil purposes.

2. Mechanical high speed cameras, in which the film does not move, capable of recording at rates exceeding 1,000,000 frames per second for the full framing height of 35 mm film, or at proportionately higher rates for lesser frame heights, or at proportionately lower rates for greater frame heights;

3. Mechanical or electronic streak cameras with writing speeds exceeding 10 mm per microsecond;

4. Electronic framing cameras having a speed exceeding 1,000,000 frames per second;

5. Electronic cameras having:

   a. An electronic shutter speed (gating capability) of less than 1 microsecond per full frame; and

   b. A read out time allowing a framing rate of more than 125 full frames per second;

(b) Imaging cameras, as follows:

Note: Head b. of this entry does not specify television or video cameras specially designed for television broadcasting.

1. Video cameras incorporating solid state sensors, having any of the following;

   a. More than 4×10^6 active pixels per solid state array for monochrome (black and white) cameras;

   b. More than 4×10^6 active pixels per solid state array for colour cameras incorporating three solid state arrays; or

(**32**) See also Entry 6A203.

c. More than 12×10^6 active pixels for solid state array colour cameras incorporating one solid state array;

2. Scanning cameras and scanning camera systems:

a. Incorporating linear detector arrays with more than 8,192 elements per array; and

b. Having mechanical scanning in one direction;

3. Incorporating image intensifiers specified in sub—head a.2.a. of this entry;

4. Incorporating focal plane arrays specified in sub—head a.3. of this entry.

Note: For cameras specially designed or modified for underwater use, see heads d. and e. of entry 8A002.

6A004

Optics

(a) Optical mirrors (reflectors), as follows:

1. Deformable mirrors with either continuous or multi—element surfaces, and specially designed components therefor, capable of dynamically repositioning portions of the surface of the mirror at rates exceeding 100 Hz;

2. Lightweight monolithic mirrors with an average equivalent density of less than 30 kg/m^2 and a total weight exceeding 10 kg;

3. Lightweight composite or foam mirror structures with an average equivalent density of less than 30 kg/m^2 and a total weight exceeding 2 kg;

4. Beam steering mirrors more than 100 mm in diameter or length of major axis with a control bandwidth exceeding 100 Hz;

(b) Optical components made from zinc selenide (ZnSe) or zinc sulphide (ZnS) with transmission in the wavelength range exceeding 3,000 nm but not exceeding 25,000 nm and either of the following:

1. Exceeding 100 cm^3 in volume; or

2. Exceeding 80 mm in diameter or length of major axis and 20 mm in thickness (depth);

(c) Space—qualified components for optical systems, as follows:

1. Lightweighted to less than 20% equivalent density compared with a solid blank of the same aperture and thickness;

2. Substrates, substrates with surface coatings (single—layer or multi—layer, metallic or dielectric, conducting, semiconducting or insulating) or with protective films;

3. Segments or assemblies of mirrors designed to be assembled in space into an optical system with a collecting aperture equivalent to or larger than a single optic 1 metre in diameter;

4. Manufactured from composite materials having a coefficient of linear thermal expansion equal to or less than $5 \times 10^{6-}$ in any coordinate direction;

(d) Optical filters, as follows:

1. For wavelengths longer than 250 nm, comprised of multi—layer optical coatings and having either of the following:

a. Bandwidths equal to or less than 1 nm Full Width Half Intensity (FWHI) and peak transmission of 90% or more; or

b. Bandwidths equal to or less than 0·1 nm FWHI and peak transmission of 50% or more;

Note: Sub—head d.1. of this entry does not specify optical filters with fixed air gaps or Lyot—type filters.

2. For wavelengths longer than 250 nm, having all of the following:

a. Tunable over a spectral range of 500 nm or more;

b. Instantaneous optical bandpass of 1·25 nm or less;

c. Wavelength resettable within 0·1 ms to an accuracy of 1 nm or better within the tunable spectral range; and

d. A single peak transmission of 91% or more;

3. Optical opacity switches (filters) with a field of view of 30° or wider and a response time equal to or less than 1 ns;

(e) Optical control equipment, as follows:

1. Specially designed to maintain the surface figure or orientation of the space—qualified components specified in sub—heads c.1. or c.3. of this entry;

2. Having steering, tracking, stabilization or resonator alignment bandwidths equal to or more than 100 Hz and an accuracy of 10 microradians or less;

3. Gimbals having a maximum slew exceeding 5°, a bandwidth equal to or more than 100Hz, and either of the following:

(a) 1. Exceeding 0·15m but not exceeding 1m in diameter or major axis length;

2. Capable of angular accelerations exceeding 2 radians/s^2; and

3. Having angular pointing errors equal to or less than 200 microradians; or

(b) 1. Exceeding 1m in diameter or major axis length;

2. Capable of angular accelerations exceeding 0·5 radians/s^2; and

3. Having angular pointing errors equal to or less than 200 microradians;

4. Specially designed to maintain the alignment of phased array or phased segment mirror systems consisting of mirrors with a segment diameter or major axis length of 1m or more;

(f) Fluoride fibre cable, or optical fibres therefor, having an attenuation of less than 4dB/km in the wavelength range exceeding 1,000nm but not exceeding 3,000nm.

6A005

Lasers, components and optical equipment, as follows(**33**):

Notes:

1. Pulsed lasers include those that run in a continuous wave (CW) mode with pulses superimposed.

2. Pulse—excited lasers include those that run in a continuously excited mode with pulse excitation superimposed.

(**33**) See also entry 6A205.

3. The status of Raman lasers is determined by the parameters of the pumping source lasers. The pumping source lasers can be any of the lasers described below.

(a) Gas lasers, as follows:

(1) Excimer lasers having any of the following:

(a) An output wavelength not exceeding 150nm and:

(1) An output energy exceeding 50mJ per pulse; or

(2) An average or CW output power exceeding 1W;

(b) An output wavelength exceeding 150nm but not exceeding 190nm and:

(1) An output energy exceeding 1·5J per pulse; or

(2) An average or CW output power exceeding 120W;

(c) An output wavelength exceeding 190nm but not exceeding 360nm and:

(1) An output energy exceeding 10J per pulse; or

(2) An average or CW output power exceeding 500W; or

(d) An output wavelength exceeding 360nm and:

(1) An output energy exceeding 1·5J per pulse; or

(2) An average or CW output power exceeding 30W;

2. Metal vapour lasers, as follows:

(a) Copper (Cu) lasers with an average or CW output power exceeding 20W;

(b) Gold (Au) lasers with an average or CW output power exceeding 5W;

(c) Sodium (Na) lasers with an output power exceeding 5W;

(d) Barium (Ba) lasers with an average or CW output power exceeding 2W;

3. Carbon monoxide (CO) lasers having either:

(a) An output energy exceeding 2J per pulse and a pulsed peak power exceeding 5kW; or

(b) An average or CW output power exceeding 5kW;

4. Carbon dioxide (CO_2) lasers having any of the following:

(a) A CW output power exceeding 10kW;

(b) A pulsed output with a pulse duration exceeding 10 microseconds and:

(1) An average output power exceeding 10kW; or

(2) A pulsed peak power exceeding 100kW; or

(c) A pulsed output with a pulse duration equal to or less than 10 microseconds and:

(1) A pulse energy exceeding 5J per pulse and peak power exceeding 2·5kW; or

(2) An average output power exceeding 2·5kW;

5. Chemical lasers, as follows:

(a) Hydrogen Fluoride (HF) lasers;

(b) Deuterium Fluoride (DF) lasers;

(c) Transfer lasers:

(1) Oxygen Iodine (O_2—I) lasers;

(2) Deuterium Fluoride—Carbon dioxide (DF—CO_2) lasers;

6. Gas discharge and ion lasers, i.e., krypton ion or argon ion lasers, as follows:

(a) An output energy exceeding 1·5J per pulse and a pulsed peak power exceeding 50W; or

(b) An average or CW output power exceeding 50W; or

7. Other gas lasers, except nitrogen lasers, having any of the following:

(a) An output wavelength not exceeding 150nm and:

(1) An output energy exceeding 50mJ per pulse and a pulsed peak power exceeding 1W; or

(2) An average or CW output power exceeding 1W;

(b) An output wavelength exceeding 150nm but not exceeding 800nm and:

(1) An output energy exceeding 1·5J per pulse and a pulsed peak power exceeding 30W; or

(2) An average or CW output power exceeding 30W;

(c) An output wavelength exceeding 800nm but not exceeding 1,400nm and:

(1) An output energy exceeding 0·25J per pulse and a pulsed peak power exceeding 10W; or

(2) An average or CW output power exceeding 10W; or

(d) An output wavelength exceeding 1,400nm and an average or CW output power exceeding 1W;

(b) Semiconductor lasers, as follows:

Technical Note:Semiconductor lasers are commonly called laser diodes.

Note: Semiconductor lasers specially designed for other equipment are evaluated against the entry that refers to the other equipment.

(1) Individual, single—transverse mode semiconductor lasers having:

(a) An average output power exceeding 100mW; or

(b) A wavelength exceeding 1,050nm;

(2) Individual, multiple—transverse mode semiconductor lasers, or arrays of individual semiconductor lasers, having:

(a) An output energy exceeding 500 microjoules per pulse and a pulsed peak power exceeding 10W;

(b) An average or CW output power exceeding 10W; or

(c) A wavelength exceeding 1,050nm;

(c) Solid state lasers, as follows:

(1) Tunable lasers having any of the following:

Note: Sub—head c.1. of this entry includes titanium—sapphire (Ti: Al_2O_3), thulium —YAG (Tm: YAG), thulium—YSGG (Tm: YSGG), alexandrite (Cr: $BeAl_2O_4$) and colour centre lasers.

(a) An output wavelength less than 600nm and:

(1) An output energy exceeding 50mJ per pulse and a pulsed peak power exceeding 1W; or

(2) An average or CW output power exceeding 1W;

(b) An output wavelength of 600nm or more but not exceeding 1,400nm and:

(1) An output energy exceeding 1J per pulse and a pulsed peak power exceeding 20W; or

(2) An average or CW output power exceeding 20W; or

(c) An output wavelength exceeding 1,400nm and:

(1) An output energy exceeding 50mJ per pulse and a pulsed peak power exceeding 1W; or

(2) An average or CW output power exceeding 1W;

2. Non—tunable lasers, as follows:

Note: Sub—head c.2. of this entry includes atomic transition solid state lasers.

(a) Ruby lasers having an output energy exceeding 20J per pulse;

(b) Neodymium glass lasers, as follows:

(1) Q—switched lasers having:

(a) An output energy exceeding 20J but not exceeding 50J per pulse and an average output power exceeding 10W; or

(b) An output energy exceeding 50J per pulse;

(2) Non—Q—switched lasers having:

(a) An output energy exceeding 50J but not exceeding 100J per pulse and an average output power exceeding 20W; or

(b) An output energy exceeding 100J per pulse;

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

Note: For Neodymium—doped (other than glass) lasers having an output wavelength not exceeding 1,000nm or exceeding 1,100nm, see sub—head c.2.d. of this entry.

(1) Pulse excited, mode—locked, Q—switched lasers with a pulse duration of less than 1ns and:

(a) A peak power exceeding 5GW;

(b) An average output power exceeding 10W; or

(c) A pulsed energy exceeding 0·1J;

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

(a) A single—transverse mode output with:

(1) A peak power exceeding 100MW;

(2) An average output power exceeding 20W; or

(3) A pulsed energy exceeding 2J; or

(b) A multiple—transverse mode output with:

(1) A peak power exceeding 200MW;

(2) An average output power exceeding 50W; or

(3) A pulsed energy exceeding 2J;

3. Pulse—excited, non—Q—switched lasers, having:

(a) A single—transverse mode output with:

(1) A peak power exceeding 500kW; or

(2) An average output power exceeding 150W; or

(b) A multiple—transverse mode output with:

(1) A peak power exceeding 1MW; or

(2) An average power exceeding 500W;

4. Continuously excited lasers having:

(a) A single—transverse mode output with:

(1) A peak power exceeding 500kW; or

(2) An average or CW output power exceeding 150W; or

(b) A multiple—transverse mode output with:

(1) A peak power exceeding 1MW; or

(2) An average or CW output power exceeding 500W;

(d) Other non—tunable lasers, having any of the following:

(1) A wavelength less than 150nm and:

(a) An output energy exceeding 50mJ per pulse and a pulsed peak power exceeding 1W; or

(b) An average or CW output power exceeding 1W;

2. A wavelength of 150nm or more but not exceeding 800nm and:

(a) An output energy exceeding 1·5J per pulse and a pulsed peak power exceeding 30W; or

(b) An average or CW output power exceeding 30W;

3. A wavelength exceeding 800nm but not exceeding 1,400nm, as follows:

(a) Q—switched lasers with:

(1) An output energy exceeding 0·5J per pulse and a pulsed peak power exceeding 50W; or

(2) An average output power exceeding:

(a) 10W for single—mode lasers;

(b) 30W for multimode lasers;

(b) Non—Q—switched lasers with:

(1) An output energy exceeding 2 J per pulse and a pulsed peak power exceeding 50 W; or

(2) An average or CW output power exceeding 50 W; or

4. A wavelength exceeding 1,400 nm and:

(a) An output energy exceeding 100 mJ per pulse and a pulsed peak power exceeding 1 W; or

(b) An average or CW output power exceeding 1 W;

(d) Dye and other liquid lasers, having any of the following:

(1) A wavelength less than 150 nm and:

(a) An output energy exceeding 50 mJ per pulse and a pulsed peak power exceeding 1 W; or

(b) An average or CW output power exceeding 1 W;

(2) A wavelength of 150 nm or more but not exceeding 800 nm and:

(a) An output energy exceeding 1·5 J per pulse and a pulsed peak power exceeding 20 W;

(b) An average or CW output power exceeding 20 W; or

(c) A pulsed single longitudinal mode oscillator with an average output power exceeding 1 W and a repetition rate exceeding 1 kHz if the pulse duration is less than 100 ns;

3. A wavelength exceeding 800 nm but not exceeding 1,400 nm and:

(a) An output energy exceeding 0·5 J per pulse and a pulsed peak power exceeding 10 W; or

(b) An average or CW output power exceeding 10 W; or

4. A wavelength exceeding 1,400 nm and:

(a) An output energy exceeding 100 mJ per pulse and a pulsed peak power exceeding 1 W; or

(b) An average or CW output power exceeding 1 W;

(e) Free electron lasers;

(e) Components, as follows:

(1) Mirrors cooled either by active cooling or by heat pipe cooling;

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

(2) Optical mirrors or transmissive or partially transmissive optical or electro—optical components specially designed for use with specified lasers;

(g) Optical equipment, as follows:

(1) Dynamic wavefront (phase) measuring equipment capable of mapping at least 50 positions on a beam wavefront with:

(a) Frame rates equal to or more than 100 Hz and phase discrimination of at least 5% of the beam's wavelength; or

(b) Frame rates equal to or more than 1,000 Hz and phase discrimination of at least 20% of the beam's wavelength;

(2) Laser diagnostic equipment capable of measuring Super—High Power Laser (SHPL) system angular beam steering errors of equal to or less than 10 microradians;

(3) Optical equipment, assemblies or components specially designed for a phased—array SHPL system for coherent beam combination to an accuracy of Lambda/10 at the designed wavelength, or 0·1 micrometre, whichever is the smaller;

(4) Projection telescopes specially designed for use with SHPL systems.

Note: For shared aperture optical elements capable of operating in SHPL applications, see head d. of entry ML23 of Group 1 of Part III of this Schedule.

6A006

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

Note: This entry does not specify instruments specially designed for biomagnetic measurements for medical diagnostics, unless they incorporate unembedded sensors specified in head (h) of this entry.

(a) Magnetometers using superconductive, optically pumped or nuclear precession (proton/Overhauser) technology having a noise level (sensitivity) lower (better) than 0·05 nT rms per square root Hz;

(b) Induction coil magnetometers having a noise level (sensitivity) lower (better) than:

1. 0·05 nT rms per square root Hz at frequencies of less than 1 Hz;

2. $1\times10^{3}-$ nT rms per square root Hz at frequencies of 1 Hz or more but not exceeding 10 Hz; or

3. $1\times10^{4}-$ nT rms per square root Hz at frequencies exceeding 10 Hz;

(c) Fibre optic magnetometers having a noise level (sensitivity) lower (better) than 1 nT rms per square root Hz;

(d) Magnetic gradiometers using multiple magnetometers specified in heads a., b. or c. of this entry;

(e) Fibre optic intrinsic magnetic gradiometers having a magnetic gradient field noise level (sensitivity) lower (better) than 0·3 nT/m rms per square root Hz;

(f) Intrinsic magn;etic gradiometers, using technology other than fibre—optic technology, having a magnetic gradient field noise level (sensitivity) lower (better) than 0·015 nT/m rms per square root Hz;

(g) Magnetic compensation systems for magnetic sensors designed for operation on mobile platforms;

(h) Superconductive electromagnetic sensors, containing components manufactured from superconductive materials, as follows:

1. Designed for operation at temperatures below the critical temperature of at least one of their superconductive constituents (including Josephson effect devices or superconductive quantum interference devices (SQUIDS));
2. Designed for sensing electromagnetic field variations at frequencies of 1 kHz or less; and
3. Having any of the following characteristics:
   a. Incorporating thin—film SQUIDS with a minimum feature size of less than 2 micrometres and with associated input and output coupling circuits;
   b. Designed to operate with a magnetic field slew rate exceeding 1×10^6 magnetic flux quanta per second;
   c. Designed to function without magnetic shielding in the earth's ambient magnetic field; or
   d. Having a temperature coefficient less (smaller) than 0·1 magnetic flux quantum/K.

6A007

Gravity meters (gravimeters) and gravity gradiometers, as follows(**34**):

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

Note: Head a. of this entry does not specify ground gravity meters of the quartz element (Worden) type.

(b) Gravity meters for mobile platforms for ground, marine, submersible, space or airborne use having:

1. A static accuracy of less (better) than 0·7 milligal; and
2. An in—service (operational) accuracy of less (better) than 0·7 milligal with a time —to—steady—state registration of less than 2 minutes under any combination of attendant corrective compensations and motional influences;

(c) Gravity gradiometers.

(**34**) See also entry 6A107.

6A008

Radar systems, equipment and assemblies having any of the following characteristics, and specially designed components therefor(**35**):

Note: This entry does not specify:

(a) Secondary surveillance radar (SSR);

(b) Car radar designed for collision prevention;

(c) Displays or monitors used for air traffic control (ATC) having no more than 12 resolvable elements per mm.

(a) Operating at frequencies from 40GHz to 230GHz and having an average output power exceeding 100mW;

(b) Having a tunable bandwidth exceeding ±6·25% of the centre operating frequency;

Technical Note: The centre operating frequency equals one half of the sum of the highest plus the lowest specified operating frequencies.

(c) Capable of operating simultaneously on more than two carrier frequencies;

(d) Capable of operating in synthetic aperture (SAR), inverse synthetic aperture (ISAR) or sidelooking airborne (SLAR) radar mode;

(e) Incorporating electronically steerable phased array antennae;

(f) Capable of heightfinding non—cooperative targets;

Note: Head f. of this entry does not specify:

a. Precision approach radar equipment (PAR) conforming with International Civil Aviation Organisation (ICAO) standards published by ICAO in Annex 10 of Volume 1;

b. Meteorological (weather) radar.

(g) Designed specially for airborne (balloon or airframe mounted) operation and having Doppler signal processing for the detection of moving targets;

(h) Employing processing of radar signals using:

1. Radar spread spectrum techniques; or

2. Radar frequency agility techniques;

(i) Providing ground—based operation with a maximum instrumented range exceeding 185km;

Note: Head i. of this entry does not specify fishing ground surveillance radar.

(j) Laser radar or Light Detection and Ranging (LIDAR) equipment, having either of the following:

1. Space—qualified; or

2. Employing coherent heterodyne or homodyne detection techniques and having an angular resolution of less (better) than 20 microradians;

Note: Head j. of this entry does not specify LIDAR equipment specially designed for surveying or for meteorological observation.

(k) Having signal processing sub—systems using pulse compression with:

1. A pulse compression ratio exceeding 150; or

2. A pulse width of less than 200ns; or

(**35**) See also entry 6A108.

(l) Having data processing sub—systems with:

1. Automatic target tracking providing, at any antenna rotation, the predicted target position beyond the time of the next antenna beam passage;

   Note: Sub—head 1.1. of this entry does not specify conflict alert capability in ATC systems, or marine or harbour radar.

2. Calculation of target velocity from primary radar having non—periodic (variable) scanning rates;

3. Processing for automatic pattern recognition (feature extraction) and comparison with target characteristic data bases (waveforms or imagery) to identify or classify targets; or

4. Superposition and correlation, or fusion, of target data from two or more geographically dispersed and interconnected radar sensors to enhance and discriminate targets.

   Note: Sub—head 1.4. of this entry does not specify systems, equipment and assemblies used for marine traffic control.

6A102

Radiation hardened detectors, other than those specified in entry 6A002, for use in protecting against nuclear effects (e.g., electromagnetic pulse (EMP), X—rays, combined blast and thermal effects), and usable for missiles, designed or rated to withstand radiation levels which meet or exceed a total irradiation dose of 5×10^5 rads (Si).

Technical Note: In this entry, 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.

6A107

Specially designed components for gravity meters and gravity gradiometers specified in heads b. and c. of entry 6A007.

6A108

Radar systems and tracking systems, other than those specified in entry 6A008, as follows:

(a) Radar and laser radar systems designed or modified for use in systems specified in entries 9A004 or 9A104;

(b) Precision tracking systems, usable for missiles, as follows:

1. Tracking systems which use a translator in conjunction with either surface or airborne references or navigation satellite systems to provide real—time measurements of in—flight position and velocity;

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

   a. angular resolution better than 3 milliradians (0·5mils);

   b. range of 30km or greater with a range resolution better than 10mrms;

   c. velocity resolution better than 3m/s.

6A202

Photomultiplier tubes with a photocathode area of greater than $20cm^2$ having an anode pulse rise time of less than 1ns.

6A203

Cameras and components, other than those specified in entry 6A003, as follows:

(a) Mechanical rotating mirror cameras and specially designed components therefor, as follows:

1. Mechanical framing cameras with recording rates greater than 225,000 frames per second;
2. Streak cameras with writing speeds greater than 0·5mm per microsecond;

   Technical Note: components of such cameras include specially designed synchronizing electronics and specially designed rotor assemblies (consisting of turbines, mirrors and bearings).

(b) Electronic streak and framing cameras and tubes, as follows:

1. Electronic streak cameras capable of 50ns or less time resolution and streak tubes therefor;
2. Electronic (or electronically shuttered) framing cameras capable of 50ns or less frame exposure time;
3. Framing tubes and solid—state imaging devices for use with cameras specified in sub—head b.2. of this entry, as follows:
   a. Proximity focused image intensifier tubes having the photocathode deposited on a transparent conductive coating to decrease photocathode sheet resistance;
   b. Gate silicon intensifier target (SIT) videcon tubes, where a fast system allows gating the photoelectrons from the photocathode before they impinge on the SIT plate;
   c. Kerr or pockel cell electro—optical shuttering; or
   d. Other framing tubes and solid—state imaging devices having a fast—image gating time of less than 50ns specially designed for cameras specified in sub—head b.2. of this entry;

(c) Radiation—hardened TV cameras specially designed or rated as radiation hardened to withstand greater than 5×10^4 grays (Si) (5×10^6 rad (Si)) without operational degradation and specially designed lenses used therein.

6A205

Lasers, other than those specified in entry 6A005, as follows:

(a) Argon ion lasers with greater than 40W average output power operating at wavelengths between 400nm and 515nm;

(b) Tunable pulsed single—mode dye oscillators capable of an average power output of greater than 1W, a repetition rate greater than 1kHz, a pulse less than 100ns, and a wavelength between 300nm and 800nm;

(c) Tunable pulsed dye laser amplifiers and oscillators, with an average power output of greater than 30W, a repetition rate greater than 1kHz, a pulse width less than 100ns, and a wavelength between 300nm and 800nm;

except:

Single mode oscillators;

(d) Pulsed carbon dioxide lasers with a repetition rate greater than 250Hz, an average power output of greater than 500W, and a pulse of less than 200ns operating at wavelengths between 9,000nm and 11,000nm;

(e) Para—hydrogen Raman shifters designed to operate at 16 micro metres output wavelength and at a repetition rate greater than 250Hz.

6A225

Velocity interferometers for measuring velocities in excess of 1km/s during time intervals of less than 10 microsecond (VISARs, Doppler laser interferometers (DLIs), etc.).

6A226

Pressure sensors, as follows:

(a) Manganin gauges for pressures greater than 100 kilobars; or

(b) Quartz pressure transducers for pressures greater than 100 kilobars.

Test, Inspection and Production Equipment

6B

6B004

Equipment for measuring absolute reflectance to an accuracy of ±0·1% of the reflectance value.

6B005

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

(a) For the manufacture or inspection of:

1. Free electron laser magnet wigglers;

2. Free electron laser photo injectors;

(b) For the adjustment, to required tolerances, of the longitudinal magnetic field of free electron lasers.

6B007

Equipment to produce, align and calibrate land—based gravity meters with a static accuracy of better than 0·1 milligal.

6B008

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

6B108

Systems specially designed for radar cross section measurement usable for missiles and their subsystems.

Materials

6C

6C002

Optical Sensors:

(a) Elemental tellurium (Te) of purity levels equal to or more than 99·9995%;

(b) Single crystals of cadmium telluride (CdTe) or mercury cadmium telluride (CdHgTe) of any purity level, including epitaxial wafers thereof;

Technical Note: Purity verified in accordance with ASTM F574–83 standard or equivalents.

(c) Optical fibre preforms specially designed for the manufacture of high birefringence fibres specified in sub—head d.3. of entry 6A002.

6C004

Optics:

(a) Zinc selenide (ZnSe) and zinc sulphide (ZnS) substrate blanks produced by the chemical vapour deposition process:

1. Larger than 100cm^3 in volume; or
2. Larger than 80mm in diameter with a thickness equal to or more than 20mm;

(b) Boules of the following electro—optic materials:

1. Potassium titanyl arsenate (KTA);
2. Silver gallium selenide ($AgGaSe_2$); or
3. Thallium arsenic selenide ($T1_3AsSe_3$, also known as TAS);

(c) Non—linear optical materials having:

1. Third order susceptibility (chi3) equal to or less than 1W/m^2; and
2. A response time of less than 1ms;

(d) Substrate blanks of silicon carbide or beryllium beryllium (Be/Be) deposited materials exceeding 300mm in diameter or major axis length;

(e) Low optical absorption materials, as follows:

1. Bulk fluoride compounds containing ingredients with a purity of 99·999% or better;

Note: Sub—head e.1. of this entry specifies fluorides of zirconium or aluminium and variants.

2. Bulk fluoride glass made from compounds specified in sub—head e.1. of this entry;

(f) Glass, including fused silica, phosphate glass, fluorophosphate glass, zirconium fluoride (ZrF_4) and hafnium fluoride (HfF_4) with:

1. A hydroxyl ion (OH—) concentration of less than 5ppm;
2. Integrated metallic purity levels of less than 1ppm; and
3. High homogeneity (index of refraction variance) less than 5×10^{6}–;

(g) Synthetically produced diamond material with an absorption of less than 10^{5}– cm^{1}– for wavelengths exceeding 200nm but not exceeding 14,000nm;

(h) Optical fibre preforms made from bulk fluoride compounds containing ingredients with a purity of 99·999% or better, specially designed for the manufacture of fluoride fibres specified in head f. of entry 6A004.

6C005

Crystalline laser host material in unfinished form, as follows:

(a) Titanium doped sapphire;

(b) Alexandrite.

Software

6D

6D001

Software specially designed for the development or production of goods specified in entries 6A004, 6A005, 6A008 or 6B008.

6D002

Software specially designed for the use of goods specified in head b. of entry 6A002, or entries 6A008 or 6B008.

6D003

Other software, as follows:

(a) 1. Software specially designed for acoustic beam forming for the real time processing of acoustic data for passive reception using towed hydrophone arrays;

2. Source code for the real time processing of acoustic data for passive reception using towed hydrophone arrays;

(b) 1. Software specially designed for magnetic compensation systems for magnetic sensors designed to operate on mobile platforms;

2. Software specially designed for magnetic anomaly detection on mobile platforms;

(c) Software specially designed to correct motional influences of gravity meters or gravity gradiometers;

(d) 1. Air Traffic Control software application programmes hosted on general purpose computers located at Air Traffic Control centres and capable of any of the following:

a. Processing and displaying more than 150 simultaneous system tracks;

b. Accepting radar target data from more than four primary radars; or

c. Automatically handing over primary radar target data (if not correlated with secondary surveillance radar (SSR) data) from the host ATC centre to another ATC centre;

2. Software for the design or production of radomes which:

a. Are specially designed to protect the electronically steerable phased array antennae specified in head e. of entry 6A008; and

b. Limit the average side—lobe level increase by less than 13 dB for frequencies equal to or higher than 2 GHz.

6D102

Software specially designed for the use of goods specified in entry 6A108.

6D103

Software which processes post—flight, recorded data, obtained from the systems specified in head b. of entry 6A108, enabling determination of vehicle position throughout its flight path.

Technology

6E

6E001

The export of goods specified in this entry is only prohibited to any destination in any country listed in Schedule 2.

Technology required for the development of goods specified in sub—categories 6A, 6B, 6C or 6D.

6E002

The export of goods specified in this entry is only prohibited to any destination in any country listed in Schedule 2.

Technology required for the production of goods specified in sub—categories 6A, 6B or 6C.

6E003

The export of goods specified in this entry is only prohibited to any destination in any country listed in Schedule 2.

Other technology, as follows:

(a) 1. Optical surface coating and treatment technology required to achieve uniformity of 99·5% or better for optical coatings 500 mm or more in diameter or major axis length and with a total loss (absorption and scatter) of less than 5×10^3—3

2. Optical fabrication technologies, as follows:

(a) For serially producing optical components at a rate exceeding 10 m^2 of surface area per year on any single spindle and with:

1. An area exceeding 1 m^2; and

2. A surface figure exceeding lambda/10 rms at the designed wavelength;

(b) Single point diamond turning techniques producing surface finish accuracies of better than 10 nm rms on non—planar surfaces exceeding 0·5 m^2;

(See also head d. of entry 2E003).

(b) 1. Technology for optical filters with a bandwidth equal to or less than 10 nm, a field of view (FOV) exceeding 40° and a resolution exceeding 0·75 line pairsper mm;

2. Technology required for the development, production or use of specially designed diagnostic instruments or targets in test facilities for Super High Power Lasers (SHPL) testing or testing or evaluation of materials irradiated by SHPL beams;

(c) Technology required for the development or production of fluxgate magnetometers or fluxgate magnetometer systems having a noise level:

1. Less than 0·05 nT rms per square root Hz at frequencies of less than 1 Hz; or

2. 1×10^3— nT rms per square root Hz at frequencies of 1 Hz or more.

6E101

Technology required for the use of goods specified in entry 6A002, heads b. and c. of entry 6A007, entries 6A008, 6A102, 6A107, 6A108, 6B108, 6D102 or 6D103.

Note: This entry only specifies technology for goods specified in entry 6A008 when it is designed for airborne applications and is usable in missiles.

6E201

Technology required for the use of goods specified in entry 6A003, sub—head a.1.c. of entry 6A005, sub—head a.2.a. of entry 6A005, sub—head c.1.b. of entry 6A005,sub—head c.2.c.2. of entry 6A005, sub—head c.2.d.2.b. of entry 6A005, entries 6A202, 6A203, 6A205, 6A225, or 6A226.
Category 7Navigation and Avionics

Equipment, Assemblies and Components

7A

7A001

Accelerometers designed for use in inertial navigation or guidance systems and having any of the following characteristics, and specially designed components therefor(**36**):

(a) A bias stability of less (better) than 130 micro g with respect to a fixed calibration value over a period of one year;

(b) A scale factor stability of less (better) than 130 ppm with respect to a fixed calibration value over a period of one year;

(c) Specified to function at linear acceleration levels exceeding 100 g.

7A002

Gyros having any of the following characteristics, and specially designed components therefor(**37**):

(a) A drift rate stability, when measured in a 1 g environment over a period of three months and with respect to a fixed calibration value, of:

1. Less (better) than 0·1° per hour when specified to function at linear acceleration levels below 10 g; or

2. Less (better) than 0·5° per hour when specified to function at linear acceleration levels from 10 g to 100 g inclusive;

(b) Specified to function at linear acceleration levels above 100 g.

7A003

Inertial navigation systems (gimballed and strapdown) and inertial equipment for attitude, guidance or control having any of the following characteristics, and specially designed components therefor(**38**):

(a) For aircraft:

(**36**) See also entry 7A101.
(**37**) See also entry 7A102.
(**38**) See also entry 7A103.

1. Navigation error (free inertial) of 0·8 nautical mile per hour (50% Circular Error Probable (CEP)) or less (better) subsequent to normal alignment;
2. Not certified for use on civil aircraft by civil aviation authorities; or
3. Specified to function at linear acceleration levels exceeding 10 g;

(b) For land or spacecraft:

1. Navigation error (free inertial) of 0·8 nautical mile per hour (50% CEP) or less (better) subsequent to normal alignment; or
2. Specified to function at linear acceleration levels exceeding 10 g.

7A004

Gyro—astro compasses, and other devices which derive position or orientation by means of automatically tracking celestial bodies or satellites, with an azimuth accuracy of equal to or less (better) than 5 seconds of arc(**39**).

7A005

Global Positioning Satellite (GPS) receiving equipment having either of the following characteristics, and specially designed components therefor(**40**):

(a) Employing encryption/decryption; or

(b) A null—steerable antenna.

7A006

Airborne altimeters operating at frequencies other than 4·2 to 4·4 GHz inclusive, having either of the following characteristics(**41**):

(a) Power management; or

(b) Using phase shift key modulation.

(For automatic pilots for underwater vehicles, see Category 8, for radar, see Category 6.)

7A101

Accelerometers, other than those specified in entry 7A001, 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.

7A102

All types of gyros, other than those specified in entry 7A002, usable in missiles, with a rated drift rate stability of less than 0·5° (1 sigma or rms) per hour in a 1 g environment.

7A103

Instrumentation, navigation and direction finding equipment and systems, other than those specified in entry 7A003, as follows; and specially designed components therefor:

(**39**) See also entry 7A104.
(**40**) See also entry 7A105.
(**41**) See also entry 7A106.

(a) Inertial or other equipment using accelerometers or gyros specified in entries 7A001, 7A002, 7A101 or 7A102 and systems incorporating such equipment;

(b) Integrated flight instrument systems, which include gyrostabilisers or automatic pilots, designed or modified for use in systems specified in entries 9A004 or 9A104.

7A104

Gyro—astro compasses and other devices, other than those specified in entry 7A004, which derive position or orientation by means of automatically tracking celestial bodies or satellites and specially designed components therefor.

7A105

Global Positioning Systems (GPS) or similar satellite receivers, other than those specified in entry 7A005, capable of providing navigation information under the following operational conditions and designed or modified for use in systems specified in entry 9A004 or 9A104:

(a) At speeds in excess of 515m/s; and

(b) At altitudes in excess of 18km.

7A106

Altimeters, other than those specified in entry 7A006, of radar or laser radar type, designed or modified for use in systems specified in entry 9A004 or 9A104.

7A115

Passive sensors for determining bearing to specific electromagnetic source (direction finding equipment) or terrain characteristics, designed or modified for use in systems specified in entry 9A004 or 9A104.

Note: This entry includes sensors for the following equipment:

(a) Terrain contour mapping equipment;

(b) Imaging sensor equipment;

(c) Interferometer equipment.

7A116

Flight Control systems, as follows; designed or modified for systems specified in entry 9A004 or 9A104:

(a) Hydraulic, mechanical, electro—optical, electro—mechanical or fly by wire types;

(b) Attitude control equipment.

7A117

Guidance sets, usable in missiles, capable of achieving system accuracy of 3·33% or less of the range (e.g., a CEP of 10km or less at a range of 300km).

Test, Inspection and Production Equipment

7B

7B001

Test, calibration or alignment equipment specially designed for equipment specified in sub—category 7A except: equipment for Maintenance Level I or Maintenance Level II.

Technical Notes:

(a) Maintenance Level I

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

(b) Maintenance Level II

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

NB: Maintenance Level II does not include the removal of specified accelerometers or gyro sensors from the (SRA.

7B002

Equipment, as follows(**42**), specially designed to characterize mirrors for ring laser gyros:

(a) Scatterometers having a measurement accuracy of 10ppm or less (better);

(b) Profilometers having a measurement accuracy of 0·5nm (5 angstrom) or less (better).

7B003

Equipment specially designed for the production of equipment specified in sub—category 7A, including:

(a) Gyro tuning test stations;

(b) Gyro dynamic balance stations;

(c) Gyro run—in/motor test stations;

(d) Gyro evacuation and fill stations;

(e) Centrifuge Fixture for Gyro bearing;

(f) Accelerometer axis align stations.

7B102

Reflectometers specially designed to characterise mirrors, for laser gyros, having a measurement accuracy of 50ppm or less (better).

7B103

Specially designed production facilities for equipment specified in entry 7A117.

(**42**) See also entry 7B102.

Materials

7C None.

Software

7D

7D001

Software specially designed or modified for the development or production of goods specified in sub—categories 7A or 7B.

7D002

Source code for the use of any inertial navigation equipment or Attitude Heading Reference Systems (AHRS) (except: gimballed AHRS) including inertial equipment not specified in entries 7A003 or 7A004.

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

7D003

Other software, as follows:

(a) Software specially designed or modified to improve the operational performance or reduce the navigational error of systems to the levels specified in entries 7A003 or 7A004;

(b) Source code for hybrid integrated systems which improves the operational performance or reduces the navigational error of systems to the level specified in entry 7A003 by continuously combining inertial data with any of the following navigation data:

1. Doppler radar velocity;
2. Global Positioning Satellite (GPS) references; or
3. Terrain data base;

(c) Source code for integrated avionics or mission systems which combine sensor data and employ knowledge—based expert systems;

(d) Source code for the development of:

1. Digital flight management systems for flight path optimization;
2. Integrated propulsion and flight control systems;
3. Fly—by—wire or fly—by—light control systems;
4. Fault—tolerant or self—reconfiguring active flight control systems;
5. Airborne automatic direction finding equipment;
6. Air data systems based on surface static data;
7. Raster—type head—up displays or three dimensional displays.

7D101

Software specially designed for the use of goods specified in entries 7A001 to 7A006, 7A101 to 7A106, 7A115, 7B002, 7B003, 7B102 or 7B103.

7D102

Integration software for the goods specified in entries 7A003 or 7A103.

Technology

7E

7E001

The export of goods specified in this entry is only prohibited to any destination in any country listed in Schedule 2.

Technology required for the development of goods or software specified in sub—categories 7A, 7B or 7D.

7E002

The export of goods specified in this entry is only prohibited to any destination in any country listed in Schedule 2.

Technology required for the production of goods specified in sub—categories 7A or 7B.

7E003

The export of goods specified in this entry is only prohibited to any destination in any country listed in Schedule 2.

Technology required for the repair, refurbishing or overhaul of goods specified in entries 7A001 to 7A004;

except:

for maintenance technology directly associated with calibration, removal or replacement of damaged or unserviceable LRUs and (SRAs of a civil aircraft as described in Maintenance Level I or Maintenance Level II.

(see Technical Notes to entry 7B001)

7E004

The export of goods specified in heads a. and c. and sub—heads b.1., 2., 3., 4. and 6. of this entry is only prohibited to any destination in any country listed in Schedule 2.

Other technology, as follows:

(a) Technology for the development or production of:

1. Airborne automatic direction finding equipment operating at frequencies exceeding 5MHz;
2. Air data systems based on surface static data only, i.e., which dispense with conventional air data probes;
3. Raster—type head—up displays or three dimensional displays for aircraft;
4. Inertial navigation systems or gyro—astro compasses containing accelerometers or gyros specified in entries 7A001 or 7A002;

(b) Development technology, as follows, for active flight control systems (including fly—by—wire or fly—by—light):

1. Configuration design for interconnecting multiple microelectronic processing elements (on—board computers) to achieve real time processing for control law implementation;
2. Control law compensation for sensor location or dynamic airframe loads, ie, compensation for sensor vibration environment or for variation of sensor location from the centre of gravity;
3. Electronic management of data redundancy or systems redundancy for fault detection, fault tolerance, fault isolation or reconfiguration;
4. Note: Sub—head b.3. of this entry does not specify technology for the design of physical redundancy.
5. Flight controls which permit inflight reconfiguration of force and moment controls for real time autonomous air vehicle control;
6. Integration of digital flight control, navigation and propulsion control data into a digital flight management system for flight path optimization;
7. except:
8. development technology for aircraft flight instrument systems integrated solely for VOR, DME, ILS or MLS navigation or approaches;
9. Full authority digital flight control or multi sensor mission management systems incorporating knowledge—based expert systems;

   (For technology for Full Authority Digital Engine Control (FADEC), see sub—head a.10. of entry 9E003).

(c) Technology for the development of helicopter systems, as follows:

1. Multi—axis fly—by—wire or fly—by—light controllers which combine the functions of at least two of the following into one controlling element:

(a) Collective controls;

(b) Cyclic controls;

(c) Yaw controls;

1. Circulation—controlled anti—torque or circulation—controlled directional control systems;
2. Rotor blades incorporating variable geometry airfoils for use in systems using individual blade control.

7E101

Technology required for the use of goods specified in entries 7A001 to 7A006, 7A101 to 7A106, 7A115 to 7A117, 7B002, 7B003, 7B102, 7B103, 7D101 or 7D102.

7E102

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 the determination of hardening criteria for heads a. or b. of this entry.

7E104

Technology for the integration of the flight control, guidance, and propulsion data into a flight management system for optimization of rocket system trajectory.
Category 8Marine

Equipment, Assemblies and Components

8A

8A001

Submersible vehicles or surface vessels, as follows:

Note: For equipment for submersible vehicles, see:

Category 5 information security for encrypted communication equipment;

Category 6 for sensors;

Categories 7 and 8 for navigation equipment;

Category 8A for underwater equipment.

(a) Manned, tethered submersible vehicles designed to operate at depths exceeding 1,000m;

(b) Manned, untethered submersible vehicles:

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

(c) Unmanned, tethered submersible vehicles designed to operate at depths exceeding 1,000m:

1. Designed for self—propelled manoeuvre using propulsion motors or thrusters specified in sub—head a.2. of entry 8A002; or
2. Having a fibre optic data link;

(d) Unmanned, untethered submersible vehicles:

1. Designed for deciding a course relative to any geographical reference without real —time human assistance;
2. Having an acoustic data or command link; or
3. Having a fibre optic data or command link exceeding 1,000m;

(e) Ocean salvage systems with a lifting capacity exceeding 5MN for salvaging objects from depths exceeding 250m and having either of the following:

1. Dynamic positioning systems capable of position keeping within 20m of a given point provided by the navigation system; or
2. Seafloor navigation and navigation integration systems for depths exceeding 1,000m with positioning accuracies to within 10m of a predetermined point;

(f) Surface—effect vehicles (fully skirted variety) with a maximum design speed, fully loaded, exceeding 30 knots in a significant wave height of 1·25m (Sea State 3) or more, a cushion pressure exceeding 3,830Pa, and a light—ship—to—full—load displacement ratio of less than 0·7;

(g) Surface—effect vehicles (rigid sidewalls) with a maximum design speed, fully loaded, exceeding 40 knots in a significant wave height of 3·25m (Sea State 5) or more;

(h) Hydrofoil vessels with active systems for automatically controlling foil systems, with a maximum design speed, fully loaded, of 40 knots or more in a significant wave height of 3·25m (Sea State 5) or more;

(i) Small waterplane area vessels with:

1. A full load displacement exceeding 500 tonnes with a maximum design speed, fully loaded, exceeding 35 knots in a significant wave height of 3·25m (Sea State 5) or more; or

2. A full load displacement exceeding 1,500 tonnes with a maximum design speed, fully loaded, exceeding 25 knots in a significant wave height of 4m (Sea State 6) or more.

Technical Note: A small waterplane area vessel is defined by the following formula: waterplane area at an operational design draft less than2 × (displaced volume at the operational design draught)^{7⅔};.

8A002

Systems or equipment, as follows:

(a) Systems or equipment, specially designed or modified for submersible vehicles, designed to operate at depths exceeding 1,000m, as follows:

1. Pressure housings or pressure hulls with a maximum inside chamber diameter exceeding 1·5m;

2. Direct current propulsion motors or thrusters;

3. Umbilical cables, and connectors therefor, using optical fibre and having synthetic strength members;

(b) Systems specially designed or modified for the automated control of the motion of equipment for submersible vehicles specified in entry 8A001 using navigation data and having closed loop servo—controls to:

1. Enable a vehicle to move within 10m of a predetermined point in the water column;

2. Maintain the position of the vehicle within 10m of a predetermined point in the water column; or

3. Maintain the position of the vehicle within 10m while following a cable on or under the seabed;

(c) Fibre optic hull penetrators or connectors;

(d) Underwater vision systems, as follows:

1.

(a) Television systems (comprising camera, lights, monitoring and signal transmission equipment) having a limiting resolution when measured in air of more than 500 lines and specially designed or modified for remote operation with a submersible vehicle; or

(b) Underwater television cameras having a limiting resolution when measured in air of more than 700 lines;

Technical Note: Limiting resolution in television is a measure of horizontal resolution usually expressed in terms of the maximum number of lines per picture height discriminated on a test chart, using Institution of Electrical and Electronic Engineers (IEEE) Standard 208/1960.

1. Systems, specially designed or modified for remote operation with an underwater vehicle, employing techniques to minimise the effects of back scatter, including range—gated illuminators or laser systems;
2. Low light level television cameras specially designed or modified for underwater use containing:
    a. Image intensifier tubes specified in sub—head a.2.a. of entry 6A002; and
    b. More than 150,000 active pixels per solid state area array;

(e) Photographic still cameras specially designed or modified for underwater use, having a film format of 35mm or larger, and:
1. Annotating the film with data provided by a source external to the camera;
2. Having autofocussing or remote focussing specially designed for underwater use;
3. Having automatic back focal distance correction; or
4. Having automatic compensation control specially designed to permit an underwater camera housing to be usable at depths exceeding 1,000m;

(f) Electronic imaging systems, specially designed or modified for underwater use, capable of storing digitally more than 50 exposed images;

(g) Light systems, as follows, specially designed or modified for underwater use:
1. Stroboscopic light systems capable of a light output energy of more than 300J per flash;
2. Argon arc light systems specially designed for use below 1,000m;

(h) Robots specially designed for underwater use, controlled by using a dedicated stored programme computer:
1. Having systems that control the robot using information from sensors which measure force or torque applied to an external object, distance to an external object, or tactile sense between the robot and an external object; or
2. Capable of exerting a force of 250N or more or a torque of 250Nm or more and using titanium based alloys or fibrous or filamentary composite materials in their structural members;

(i) Remotely controlled articulated manipulators specially designed or modified for use with submersible vehicles:
1. Having systems which control the manipulator using the information from sensors which measure the torque or force applied to an external object, or tactile sense between the manipulator and an external object; or
2. Controlled by proportional master—slave techniques or by using a dedicated stored programme computer, and having 5 degrees of freedom of movement or more;

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

(j) Air independent power systems, as follows, specially designed for underwater use:
1. Brayton, Stirling or Rankine cycle engine air independent power systems having any of the following:

a. Chemical scrubber or absorber systems specially designed to remove carbon dioxide, carbon monoxide and particulates from recirculated engine exhaust;

b. Systems specially designed to use a monoatomic gas;

c. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10kHz, or special mounting devices for shock mitigation; or

d. Systems specially designed:

1. To pressurise the products of reaction or for fuel reformation;

2. To store the products of the reaction; and

3. To discharge the products of the reaction against a pressure of 100kPa or more;

2. Diesel cycle engine air independent systems, having all of the following:

a. Chemical scrubber or absorber systems specially designed to remove carbon dioxide, carbon monoxide and particulates from recirculated engine exhaust;

b. Systems specially designed to use a monoatomic gas;

c. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10kHz or special mounting devices for shock mitigation; and

d. Specially designed exhaust systems that do not exhaust continuously the products of combustion;

3. Fuel cell air independent power systems with an output exceeding 2kW having either of the following:

a. Devices or enclosures specially designed for underwater noise reduction in frequencies below 10kHz or special mounting devices for shock mitigation; or

b. Systems specially designed:

1. To pressurise the products of reaction or for fuel reformation;

2. To store the products of the reaction; and

3. To discharge the products of the reaction against a pressure of100kPa or more;

(k) Skirts, seals and fingers, as follows:

1. Designed for cushion pressures of 3,830Pa or more, operating in a significant wave height of 1·25m (Sea State 3) or more and specially designed for surface effect vehicles (fully skirted variety) specified in head f. of entry 8A001;

2. Designed for cushion pressures of 6,224Pa or more, operating in a significant wave height of 3·25m (Sea State 5) or more and specially designed for surface effect vehicles (rigid sidewalls) specified in head g. of entry 8A001;

(l) Lift fans rated at more than 400kW specially designed for surface effect vehicles specified in heads f. or g. of entry 8A001;

(m) Fully submerged subcavitating or supercavitating hydrofoils specially designed for vessels specified in head h. of entry 8A001;

(n) Active systems specially designed or modified to control automatically the sea—induced motion of vehicles or vessels specified in heads f., g., h. or i. of entry 8A001;

(o) 1. Water—screw propeller or power transmission systems, as follows, specially designed for surface effect vehicles (fully skirted or rigid sidewall variety),

hydrofoils or small waterplane area vessels specified in heads f., g., h. or i. of entry 8A001:

a. Supercavitating, super—ventilated, partially—submerged or surface piercing propellers rated at more than 7·5MW;

b. Contrarotating propeller systems rated at more than 15MW;

c. Systems employing pre—swirl or post—swirl techniques for smoothing the flow into a propeller;

d. Light—weight, high capacity (K factor exceeding 300) reduction gearing;

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

(o) 1. Water—screw propeller, power generation or transmission systems for use on vessels, as follows:

a. Controllable—pitch propellers and hub assemblies rated at more than 30MW;

b. Internally liquid—cooled electric propulsion engines with a power output exceeding 2·5MW;

c. Superconductive propulsion engines, or permanent magnet electric propulsion engines, with a power output exceeding 0·1MW;

d. Power transmission shaft systems, incorporating composite material components, capable of transmitting more than 2MW;

e. Ventilated or base—ventilated propeller systems rated at more than 2·5MW;

(o) 1. Noise reduction systems for use on vessels of 1,000 tonnes displacement or more, as follows:

a. Noise reduction systems that attenuate at frequencies below 500Hz and consist of compound acoustic mounts for the acoustic isolation of diesel engines, diesel generator sets, gas turbines, gas turbine generator sets, propulsion motors or propulsion reduction gears, specially designed for sound or vibration isolation, having an intermediate mass exceeding 30% of the equipment to be mounted;

b. Active noise reduction or cancellation systems, or magnetic bearings, specially designed for power transmission systems, and incorporating electronic control systems capable of actively reducing equipment vibration by the generation of anti—noise or anti—vibration signals directly to the source;

(p) Pumpjet propulsion systems with a power output exceeding 2·5MW using divergent nozzle and flow conditioning vane techniques to improve propulsive efficiency or reduce propulsion—generated underwater—radiated noise.

(For underwater communications systems, see Category 5 Telecommunications.)

8A990

The export of goods specified in this entry is only prohibited to any destination in Iran or Iraq.

Vessels, other than those specified in entry 8A001, as follows; and specially designed components therefor;

(a) Vessels having special structural features for landing personnel and/or vehicles on a beach;

(b) Vessels capable of supporting helicopter operations and maintenance;

(c) Vessels capable of submerging;

(d) Vessels not elsewhere specified in this Part of this Schedule of below 100 tonnes GRT including inflatable craft in an inflated or uninflated state;

except:

Light vessels, fire floats and dredgers.

8A991

The export of goods specified in this entry is only prohibited to any destination in Libya.

Vessels with decks and platforms specially strengthened to receive weapons, other than those specified in entry 8A001, and specially designed components therefor.

Test, Inspection and Production Equipment

8B

8B001

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

Materials

8C

8C001

Syntactic foam for underwater use:

(a) Designed for marine depths exceeding 1,000m; and

(b) With a density less than 561kg/m^3.

Technical Note: Syntactic foam consists of hollow spheres of plastic or glass embedded in a resin matrix.

Software

8D

8D001

Software specially designed or modified for the development, production or use of goods specified in sub—categories 8A, 8B or 8C.

8D002

Specific software specially designed or modified for the development, production, repair, overhaul or refurbishing (re—machining) of propellers specially designed for underwater noise reduction.

Technology

8E

8E001

The export of goods specified in this entry is only prohibited to any destination in any country listed in Schedule 2.

Technology required for the development or production of goods specified in entries 8A001 and 8A002, or sub—categories 8B or 8C.

8E002

The export of goods specified in this entry is only prohibited to any destination in any country listed in Schedule 2.

Other technology, as follows:

(a) Technology for the development, production, repair, overhaul or refurbishing(re—machining) of propellers specially designed for underwater noise reduction;

Note: For the purpose of head a. of this entry, a licence granted in relation to propellers which are specially designed for underwater noise reduction, does not authorize the export of any related repair technology.

(b) Technology for the overhaul or refurbishing of equipment specified in entry 8A001, or heads b., j., o. or p. of entry 8A002.

8E990

The export of goods specified in this entry is only prohibited to any destination in Iran or Iraq.

Technology required for the development, production or use of goods specified in entry 8A990.

8E991

The export of goods specified in this entry is only prohibited to any destination in Libya.

Technology required for the development, production or use of goods specified in entry 8A991.
Category 9Propulsion Systems, Space Vehicles and Related Equipment

Equipment, Assemblies and Components

9A

9A001

Aero gas turbine engines incorporating any of the technologies specified in head a. of entry 9E003, as follows(**43**):

(a) Not certified for the specific civil aircraft for which they are intended;

(b) Not certified for civil use by the aviation authorities in a relevant country;

Note: For the purposes of head b. of this entry, `relevant country' means an authority in Australia, Belgium, Canada, Denmark, Eire, France, Germany, Greece, Italy, Japan, Luxembourg, Netherlands, Norway, Portugal, Spain, Turkey, United Kingdom or United States of America.

(c) Designed to cruise at speeds exceeding Mach 1·2 for more than thirty minutes.

(**43**) See also entry 9A101.

9A002

Marine gas turbine engines with an ISO standard continuous power rating of 13,795kW or more and a specific fuel consumption of less than 0·243kg/kWh, and specially designed assemblies and components therefor.

9A003

Specially designed assemblies and components, incorporating any of the technologies specified in head a. of entry 9E003, for the following gas turbine engine propulsion systems:

(a) Specified in entry 9A001; or

(b) Whose design or production origins are either any country listed in Schedule 2 or are unknown to the manufacturer.

Note: This entry does not specify multiple domed combustors operating at average burner outlet temperatures equal to or less than 1,813K (1,540°C).

9A004

Space launch vehicles or spacecraft (not including their payloads)(**44**).

(For products contained in spacecraft payloads, see the appropriate categories).

9A005

Liquid rocket propulsion systems containing any of the systems or components specified in entry 9A006(**45**).

9A006

Systems or components, as follows(**46**), specially designed for liquid rocket propulsion systems:

(a) Cryogenic refrigerators, flightweight dewars, cryogenic heat pipes or cryogenic systems specially designed for use in space vehicles and capable of restricting cryogenic fluid losses to less than 30% per year;

(b) Cryogenic containers or closed—cycle refrigeration systems capable of providing temperatures of 100K (−173°C) or less for aircraft capable of sustained flight at speeds exceeding Mach 3, launch vehicles or spacecraft;

(c) Slush hydrogen storage or transfer systems;

(d) High pressure (exceeding 17·5MPa) turbo pumps, pump components or their associated gas generator or expander cycle turbine drive systems;

(e) High—pressure (exceeding 10·6MPa) thrust chambers and nozzles therefor;

(f) Propellant storage systems using the principle of capillary containment or positive expulsion (i.e.,with flexible bladders).

9A007

Solid rocket propulsion systems with any of the following(**47**):

(a) 1. Total impulse capacity exceeding 1·1MNs; or

(**44**) See also entry 9A104.
(**45**) See also entries 9A105 and 9A119.
(**46**) See also entry 9A106.
(**47**) See also entry 9A119.

2. Specific impulse of 2·4kNs/kg or more when the nozzle flow is expanded to ambient sea level conditions for an adjusted chamber pressure of 7MPa;

(b) 1. Stage mass fractions exceeding 88%; and

2. Propellant solid loadings exceeding 86%;

(c) Any of the components specified in entry 9A008; or

(d) Insulation and propellant bonding systems using direct—bonded motor designs to provide a strong mechanical bond or a barrier to chemical migration between the solid propellant and case insulation material.

Technical Note: For the purposes of head d. of this entry, a strong mechanical bond means bond strength equal to or more than propellant strength.

9A008

Components, as follows(**48**), specially designed for solid rocket propulsion systems:

(a) Insulation and propellant bonding systems using liners to provide a strong mechanical bond or a barrier to chemical migration between the solid propellant and case insulation material;

Technical Note: For the purposes of head a. of this entry, a strong mechanical bond means bond strength equal to or more than propellant strength.

(b) Filament—wound composite motor cases exceeding 0·61m in diameter or having structural efficiency ratios (PV/W) exceeding 25km;

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

(c) Nozzles with thrust levels exceeding 45kN or nozzle throat erosion rates of less than 0·075mm/s;

(d) Movable nozzle or secondary fluid injection thrust vector control systems capable of:

1. Omni—axial movement exceeding ±5°;

2. Angular vector rotations of 20°/s or more; or

3. Angular vector accelerations of $40°/s^2$ or more.

9A009

Hybrid rocket propulsion systems(**49**) with:

(a) Total impulse capacity exceeding 1·1MNs; or

(b) Thrust levels exceeding 220kN in vacuum exit conditions.

9A010

Specially designed components or structures, for launch vehicles or launch vehicle propulsion systems, manufactured using metal matrix composite, organic composite, ceramic matrix or intermetallic reinforced materials specified in entries 1C007 or 1C010(**50**).

(**48**) See also entry 9A108.
(**49**) See also entries 9A109 and 9A119.
(**50**) See also entries 1A002 and 9A110.

9A011

Ramjet, scramjet or combined cycle engines and specially designed components therefor(**51**).

9A101

Lightweight turbojet and turbofan engines (including turbocompound engines) that are small and fuel efficient and usable in missiles, other than those specified in entry 9A001.

9A104

Sounding rockets, capable of a range of at least 300km.

9A105

Liquid propellant rocket engines usable in missiles, other than those specified in entry 9A005, having a total impulse capacity of 1·1MNs or greater(**52**).

9A106

Systems or components, other than those specified in entry 9A006, usable in missiles, as follows, specially designed for liquid rocket propulsion systems:

(a) Rocket nozzles;

(b) Thrust vector control sub—systems;

Technical Note: Examples of methods of achieving thrust vector control specified in head b. of this entry are:

a. Flexible nozzle;

b. Fluid or secondary gas injection;

c. Movable engine or nozzle;

d. Deflection of exhaust gas stream (jet vanes or probes); or

e. Thrust tabs.

(c) Liquid and slurry propellant (including oxidiser) control systems, and specially designed components therefor, designed or modified to operate in vibration environments of more than 10grms between 20Hz and 2,000Hz.

Note: The only servo valves and pumps specified in head c. of this entry are as follows:

a. Servo valves designed for flow rates of 24 litres per minute or greater, at an absolute pressure of 7MPa or greater, that have an actuator response time of less than 100ms;

b. Pumps, for liquid propellants, with shaft speeds equal to or greater than 8,000rpm or with discharge pressures equal to or greater than 7MPa.

9A108

Components, other than those specified in entry 9A008, usable in missiles, as follows, specially designed for solid rocket propulsion systems:

(a) Rocket motor cases, interior lining and insulation therefor;

Note: In this entry interior lining means suited for the bond interface between the solid propellant and the case or insulating liner. Usually a liquid polymer based dispersion of

(**51**) See also entries 9A111 and 9A118.
(**52**) See also entry 9A119.

refractory or insulating materials, e.g., carbon filled hydroxy—terminated polybutadiene (HTPB) or other polymer with added curing agents sprayed or screeded over a case interior.

(b) Rocket nozzles;

(c) Thrust vector control sub—systems.

Technical Note: Examples of methods of achieving thrust vector control specified in head c. of this entry are:

a. Flexible Nozzle;

b. Fluid or secondary gas injection;

c. Movable engine or nozzle;

d. Deflection of exhaust gas stream (jet vanes or probes); or

e. Thrust tabs.

9A109

Hybrid rocket motors, usable in missiles, other than those specified in entry 9A009, and specially designed components therefor(**53**).

9A110

Composite structures, laminates and manufactures thereof, other than those specified in entry 9A010, including resin impregnated fibre prepregs and metal coated fibre preforms therefor, specially designed for use in the systems specified in entries 9A004 or 9A104 or the subsystems specified in entries 9A005, 9A007, 9A105, 9A106, 9A108 and 9A116, made either with organic matrix or metal matrix utilising fibre or filamentary reinforcements having a specific tensile strength greater than $7{\cdot}62\times10^4$ m and a specific modulus greater than $3{\cdot}18\times10^6$ m(**54**).

9A111

Pulse jet engines, usable in missiles, and specially designed components therefor(**55**).

9A115

Launch support equipment, designed or modified for systems specified in entries 9A004 or 9A104, as follows:

(a) Apparatus and devices for handling, control, activation or launching;

(b) Vehicles for transport, handling, control, activation or launching.

9A116

Reentry vehicles, usable in missiles, and equipment designed or modified therefor, as follows:

(a) Heat shields and components therefor fabricated of ceramic or ablative materials;

(b) Heat sinks and components therefor fabricated of light—weight, high heat capacity materials;

(c) Electronic equipment specially designed for reentry vehicles.

(**53**) See also entry 9A119.
(**54**) See also entry 1A002.
(**55**) See also entries 9A011 and 9A118.

9A117

Staging mechanisms, separation mechanisms, and interstages, usable in missiles.

9A118

Devices to regulate combustion usable in engines, which are usable in missiles, specified in entries 9A011 or 9A111.

9A119

Individual rocket stages, usable in missiles, other than those specified in entries 9A005, 9A007, 9A009, 9A105 or 9A109.

9A990

The export of goods specified in this entry is only prohibited to any destination in Libya, Iran, Iraq, Syria or South Africa.

Aircraft having a maximum all up weight of 680 kg or more.

9A991

Aircraft or steerable parachutes having a maximum all up weight of not more than 680kg.

9A992

The export of goods specified in this entry is only prohibited to any destination in Libya, Iran, Iraq, Syria or South Africa.

Equipment or components specially designed for civil aircraft, other than those specified in Group 1 of Part III of this Schedule or elsewhere in this Group;

except:

Equipment and components specially designed for civil aircraft, where the aircraft type can be shown to have first flown before 1 January 1950.

Test, Inspection and Production Equipment

9B

9B001

Specially designed equipment, tooling or fixtures, as follows, for manufacturing or measuring gas turbine blades, vanes or tip shroud castings:

(a) Automated equipment using non—mechanical methods for measuring airfoil wall thickness;

(b) Tooling, fixtures or measuring equipment for the laser, water jet or ECM/EDM hole drilling processes specified in head c. of entry 9E003;

(c) Directional solidification or single crystal casting equipment;

(d) Ceramic cores or shells;

(e) Ceramic core manufacturing equipment or tools;

(f) Ceramic core leaching equipment;

(g) Ceramic shell wax pattern preparation equipment;

(h) Ceramic shell burn out or firing equipment.

9B002

On—line (real time) control systems, instrumentation (including sensors) or automated data acquisition and processing equipment, specially designed for the development of gas turbine engines, assemblies or components incorporating technologies specified in head a. of entry 9E003.

9B003

Equipment specially designed for the production or test of gas turbine brush seals designed to operate at tip speeds exceeding 335m/s, and specially designed parts or accessories therefor.

9B004

Tools, dies or fixtures for the solid state joining of gas turbine superalloy or titanium components.

9B005

On—line (real time) control systems, instrumentation (including sensors) or automated data acquisition and processing equipment, specially designed for use with the following wind tunnels or devices:

(a) Wind tunnels designed for speeds of Mach 1·2 or more;except:

those specially designed for educational purposes and having a test section size (measured laterally) of less than 250mm;

Technical Note: Test section size: the diameter of the circle, or the side of a square, or the longest side of a rectangle, at the largest test section location.

(b) Devices for simulating flow—environments at speeds exceeding Mach 5, including hot—shot tunnels, plasma arc tunnels, shock tubes, shock tunnels, gas tunnels and light gas guns;

(c) Wind tunnels or devices, other than two—dimensional sections, capable of simulating Reynolds number flows exceeding 25×10^6.

9B006

Specially designed acoustic vibration test equipment capable of producing sound pressure levels of 160dB or more (referenced to 20 micropascals) with a rated output of 4kW or more at a test cell temperature exceeding 1,273.K (1,000°C), and specially designed transducers, strain gauges, accelerometers, thermocouples or quartz heaters therefor.

9B007

Equipment specially designed for inspecting the integrity of rocket motors using non—destructive test (NDT) techniques other than planar X—ray or basic physical or chemical analysis.

N.B.:For Radiographic equipment, see sub—head e.5. of entry 3A001.

9B008

Transducers specially designed for the direct measurement of the wall skin friction of the test flow with a stagnation temperature exceeding 833K (560°C).

9B009

Tooling specially designed for producing turbine engine powder metallurgy rotor components capable of operating at stress levels of 60% of ultimate tensile strength (UTS) or more and metal temperatures of 873K (600°C) or more.

9B105

Wind tunnels for speeds of Mach 0·9 or more, usable for missiles and their subsystems.

9B106

Environmental chambers and anechoic chambers, as follows:

(a) Environmental chambers capable of simulating the following flight conditions:

1. Vibration environments of 10g RMS or greater between 20Hz and 2,000Hz and imparting forces of 5kN or greater; and
2. Altitudes of 15,000m or greater; or
3. Temperature of at least 223K (−50°C) to 398K (+125°C);

(b) Anechoic chambers capable of simulating the following flight conditions:

1. Acoustic environments at an overall sound pressure level of 140dB or greater (referenced to 20microPa) or with a rated power output of 4kW or greater; and
2. Altitudes of 15,000m or greater; or
3. Temperature of at least 223K (−50°C) to 398K (+125°C).

9B115

Specially designed production equipment for the systems, sub—systems and components specified in entries 9A005 to 9A009, 9A011, 9A101, 9A105, 9A106, 9A108, 9A109, 9A111, 9A116 to 9A119.

9B116

Specially designed production facilities for the systems, sub—systems, and components specified in entries 9A004 to 9A009, 9A011, 9A101, 9A104 to 9A106, 9A108, 9A109, 9A111, 9A116 to 9A119.

9B117

Test benches and test stands for solid or liquid propellant rockets or rocket motors, having either of the following characteristics:

(a) The capacity to handle more than 90kN of thrust; or

(b) Capable of simultaneously measuring the three axial thrust components.

Materials

9C None.

Software

9D

9D001

Software required for the development of goods or technology specified in sub—categories 9A, 9B or entry 9E003.

9D002

Software required for the production of goods specified in sub—categories 9A or 9B.

9D003

Software required for the use of full authority digital electronic engine controls (FADEC) for propulsion systems specified in sub—category 9A or equipment specified in sub—category 9B, as follows:

(a) Software in digital electronic controls for propulsion systems, aerospace test facilities or air breathing aero—engine test facilities;

(b) Fault—tolerant software used in FADEC systems for propulsion systems and associated test facilities.

9D004 Other software, as follows:

(a) Software specially designed for vibration test equipment, other than that specified in entry 2D101, using real time digital controls with individual exciters (thrusters) with a maximum thrust exceeding 100kN;

(b) 2D or 3D viscous software validated with wind tunnel or flight test data required for detailed engine flow modelling;

(c) Software required for the development or production of real time full authority electronic test facilities for engines or components specified in sub—category 9A;

(d) Software for testing aero gas turbine engines, assemblies or components, specially designed to collect, reduce and analyse data in real time, and capable of feedback control, including the dynamic adjustment of test articles or test conditions, as the test is in progress;

(e) Software specially designed to control directional solidification or single crystal casting;

(f) Software in source code, object code or machine code required for the use of active compensating systems for rotor blade tip clearance control.

Note: Head f. of this entry does not specify software embedded in non—specified equipment or required for maintenance activities associated with the calibration or repair or updates to the active compensating clearance control system.

9D101

Software specially designed for the use of goods specified in entries 9B105, 9B106, 9B116 or 9B117.

9D103

Software specially designed for modelling, simulation or design integration of missiles and their sub—systems.

Note: Software specified in this entry remains controlled when combined with specially designed hardware specified in entry 4A102.

Technology

9E

9E001

Technology required for the development of goods specified in head c. of entry 9A001, or entries 9A004 to 9A011, or sub—Categories 9B or 9D.

9E002

Technology required for the production of goods specified in head c. of entry 9A001, or entries 9A004 to 9A011 or sub—Category 9B.

Notes:

(1) Development or production technology specified in sub—Category 9E for gas turbine engines remains specified when used as use technology for repair, rebuild and overhaul.

(2) This entry does not include technical data, drawings or documentation for maintenance activities directly associated with calibration, removal or replacement of damaged or unserviceable line replaceable units, including replacement of whole engines or engine modules.

(For technology for the repair of specified structures, laminates or materials, see head f. of entry 1E002.)

9E003

The export of goods specified in this entry is only prohibited to any destination in any country listed in Schedule 2.

Other technology, as follows:

(a) Technology required for the development or production of the following gas turbine engine components or systems:

1. Directionally solidified gas turbine blades, vanes or tip shrouds rated to operate at gas path temperatures exceeding 1,593 K (1,320°C);
2. Single crystal blades, vanes or tip shrouds;
3. Multiple domed combustors operating at average burner outlet temperatures exceeding 1,643 K (1,370°C), or combustors incorporating thermally decoupled combustion liners, non—metallic liners or non—metallic shells;
4. Components manufactured from organic composite materials designed to operate above 588 K (315°C), or from metal matrix composite, ceramic matrix, intermetallic or intermetallic reinforced materials specified in entries 1A002 or 1C007;
5. Uncooled turbine blades, vanes, tip—shrouds or other components designed to operate at gas path temperatures of 1,323 K (1,050°C) or more;
6. Cooled turbine blades, vanes or tip—shrouds, other than those described insub—heads a.1. and a.2. of this entry, exposed to gas path temperatures of 1,643 K (1,370°C) or more;
7. Airfoil—to—disk blade combinations using solid state joining;
8. Gas turbine engine components using diffusion bonding technology specified in head b. of entry 2E003;
9. Damage tolerant gas turbine engine rotating components using powder metallurgy materials specified in head b. of entry 1C002;

10. FADEC for gas turbine and combined cycle engines and their related diagnostic components, sensors and specially designed components;

11. Adjustable flow path geometry and associated control systems for:

(a) Gas generator turbines;

(b) Fan or power turbines;

(c) Propelling nozzles;

Notes:

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

2. Sub—head a.11. of this entry does not specify development or production technology for adjustable flow path geometry for reverse thrust.

3. Rotor blade tip clearance control systems employing active compensating casing technology limited to a design and development data base;

4. Gas bearings for gas turbine engine rotor assemblies;

5. Wide chord hollow fan blades without part—span support;

(b) Technology required for the development or production of:

1. Wind tunnel aero—models equipped with non—intrusive sensors capable of transmitting data from the sensors to the data acquisition system;

2. Composite propeller blades or propfans capable of absorbing more than2,000 kW at flight speeds exceeding Mach 0·55;

(c) Technology required for the development or production of gas turbine engine components using laser, water jet or ECM/EDM hole drilling processes to produce holes with:

1. a. Depths more than four times their diameter;

b. Diameters less than 0·76 mm; and

c. Incidence angles equal to or less than 25°; or

2. a. Depths more than five times their diameter;

b. Diameters less than 0.4 mm; and

c. Incidence angles of more than 25°;

d. Technical Note: For the purposes of head c. of this entry, incidence angle is measured from a plane tangential to the airfoil surface at the point where the hole axis enters the airfoil surface.

(d) Technology required for the development or production of helicopter power transfer systems or tilt rotor or tilt wing aircraft power transfer systems:

1. Capable of loss—of—lubrication operation for 30 minutes or more; or

2. Having an input power—to—weight ratio equal to or more than 8·87 kW/kg;

(e) 1. Technology for the development or production of reciprocating diesel engine ground vehicle propulsion systems having all of the following:

a. A box volume of 1·2 m^3 or less;

b. An overall power output of more than 750 kW based on 80/1269/EEC(**56**) or ISO 2534; and

c. A power density of more than 700 kW/m^3 of box volume;

(**56**) OJ L375, Vol23, 31.12.80, p.46.

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

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

Width:The widest of the following:

(a) The outside dimension from valve cover to valve cover;

(b) The dimensions of the outside edges of the cylinder heads; or

(c) The diameter of the flywheel housing;

Height:The largest of the following:

(a) The dimension of the crankshaft centre—line to the top plane of the valve cover (or cylinder head) plus twice the stroke; or

(b) The diameter of the flywheel housing.

(e) 1. Technology required for the production of specially designed components, as follows, for high output diesel engines:

(a) Technology required for the production of engine systems having all of the following components employing ceramics materials specified in entry 1C007:

1. Cylinder liners;
2. Pistons;
3. Cylinder heads; and
4. One or more other components (including exhaust ports, turbochargers, valve guides, valve assemblies or insulated fuel injectors);

(b) Technology required for the production of turbocharger systems with single—stage compressors having all of the following:

1. Operating at pressure ratios of 4:1 or higher;
2. A mass flow in the range from 30 to 130 kg per minute; and
3. Variable flow area capability within the compressor or turbine sections;

(c) Technology required for the production of fuel injection systems with a specially designed multifuel (e.g., diesel or jet fuel) capability covering a viscosity range from diesel fuel (2·5 cSt at 310·8 K (37·8°C)) down to gasoline fuel (0·5 cSt at 310·8 K (37·8°C)), having both of the following:

1. Injection amount in excess of 230 mm^3 per injection per cylinder; and
2. Specially designed electronic control features for switching governor characteristics automatically depending on fuel property to provide the same torque characteristics by using the appropriate sensors;

(e) 1. Technology required for the development or production of high output diesel engines for solid, gas phase or liquid film (or combinations thereof) cylinder wall lubrication, permitting operation to temperatures exceeding 723 K (450°C), measured on the cylinder wall at the top limit of travel of the top ring of the piston.

1. Technical Note: High output diesel engines are diesel engines with a specified brake mean effective pressure of 1·8 MPa or more at a speed of 2,300 r.p.m., provided the rated speed is 2,300 r.p.m. or more.

9E101

Technology required for the development or production of goods specified in entries 9A101, 9A104 to 9A106, 9A108 to 9A111 or 9A115 to 9A119.

9E102

Technology required for the use of goods specified in entries 9A004 to 9A011, 9A101, 9A104 to 9A106, 9A108 to 9A111, 9A115 to 9A119, 9B105, 9B106, 9B115, 9B116, 9B117, 9D101 or 9D103.

9E990

The export of goods specified in this entry is only prohibited to any destination in Libya, Iran, Iraq, Syria or South Africa.

Technology required for the development, production or use of goods specified in entry 9A990.

9E991

Technology required for the development, production or use of goods specified in entry 9A991.

9E992

The export of goods specified in this entry is only prohibited to any destination in Libya, Iran, Iraq, Syria or South Africa.

Technology required for the development, production or use of goods specified in entry 9A992.

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Diethyl phosphite	1C350
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Signal processing equipment	4A003g.
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Signal processor microcircuits	3A001a.3.
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Silicon carbide (SiC) substrate blanks	6C004d.
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Valves, bellows seal	2A226
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Wafers, semiconductor with function determined	3A001a.
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Yellow fever virus	1C351
Zinc selenide (ZnSe), substrate blanks	6C004a.
Zinc sulphide (ZnS), substrate blanks	6C004a.
Zirconium fluoride (ZrF_4) glass	6C004f.
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Zirconium metal, alloys and compounds	1C234
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