CATEGORY 9

AEROSPACE AND PROPULSION

9A Systems, Equipment and Components

N.B.: for propulsion systems designed or rated against neutron or transient ionizing radiation, see the Military Goods Controls.

9A001 Aero gas turbine engines having any of the following:

N.B.: SEE ALSO 9A101.

a. incorporating any of the ″technologies″ specified in 9E003.a.; or

Note: 9A001.a. does not control aero gas turbine engines which meet all of the following:

a. certified by the civil aviation authority in a ″participating state″; and

b. intended to power non-military manned aircraft for which one of the following has been issued by a ″participating state″ for the aircraft with this specific engine type:

1. a civil Type Certificate; or

2. an equivalent document recognized by the International Civil Aviation Organisation (ICAO).

b. designed to power an aircraft to cruise at Mach 1 or higher for more than thirty minutes.

9A002 'Marine gas turbine engines' with an ISO standard continuous power rating of 24 245 kW or more and a specific fuel consumption not exceeding 0,219 kg/kWh in the power range from 35 to 100 %, and specially designed assemblies and components therefor.

Note: the term 'marine gas turbine engines' includes those industrial, or aero-derivative, gas turbine engines adapted for a ship's electric power generation or propulsion.

9A003 Specially designed assemblies and components, incorporating any of the ″technologies″ specified in 9E003.a., for the following gas turbine engine propulsion systems:

a. specified in 9A001;

b. whose design or production origins are either non-″participating States″ or unknown to the manufacturer.

9A004 Space launch vehicles and ″spacecraft″.

N.B.: SEE ALSO 9A104.

Note: 9A004 does not control payloads.

N.B.: for the control status of products contained in ″spacecraft″ payloads, see the appropriate Categories.

9A005 Liquid rocket propulsion systems containing any of the systems or components specified in 9A006.

N.B.: SEE ALSO 9A105 AND 9A119.

9A006 Systems and components specially designed for liquid rocket propulsion systems, as follows:

N.B.: SEE ALSO 9A106, 9A108 AND 9A.120.

a. cryogenic refrigerators, flightweight dewars, cryogenic heat pipes or cryogenic systems specially designed for use in space vehicles and capable of restricting cryogenic fluid losses to less than 30 % per year;

b. cryogenic containers or closed-cycle refrigeration systems capable of providing temperatures of 100 K (– 173 °C) or less for ″aircraft″ capable of sustained flight at speeds exceeding Mach 3, launch vehicles or ″spacecraft″;

c. slush hydrogen storage or transfer systems;

d. high pressure (exceeding 17,5 MPa) turbo pumps, pump components or their associated gas generator or expander cycle turbine drive systems;

9A006 *(continued)*

e. high-pressure (exceeding 10,6 MPa) thrust chambers and nozzles therefor;

f. propellant storage systems using the principle of capillary containment or positive expulsion (i.e., with flexible bladders);

g. liquid propellant injectors, with individual orifices of 0,381 mm or smaller in diameter (an area of $1{,}14 \times 10^{-3}$ cm^2 or smaller for non-circular orifices) specially designed for liquid rocket engines;

h. one-piece carbon-carbon thrust chambers or one-piece carbon-carbon exit cones with densities exceeding 1,4 g/cm^3 and tensile strengths exceeding 48 MPa.

9A007 Solid rocket propulsion systems with any of the following:

N.B.: SEE ALSO 9A107 AND 9A119.

a. total impulse capacity exceeding 1,1 MNs;

b. specific impulse of 2,4 kNs/kg or more when the nozzle flow is expanded to ambient sea level conditions for an adjusted chamber pressure of 7 MPa;

c. stage mass fractions exceeding 88 % and propellant solid loadings exceeding 86 %;

d. any of the components specified in 9A008; or

e. insulation and propellant bonding systems using direct-bonded motor designs to provide a 'strong mechanical bond' or a barrier to chemical migration between the solid propellant and case insulation material.

Technical note:

For the purposes of 9A007.e., a 'strong mechanical bond' means bond strength equal to or more than propellant strength.

9A008 Components, as follows, specially designed for solid rocket propulsion systems:

N.B.: SEE ALSO 9A108.

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 9A008.a., a 'strong mechanical bond' means bond strength equal to or more than propellant strength.

b. filament-wound "composite" motor cases exceeding 0,61 m in diameter or having 'structural efficiency ratios (PV/W)' exceeding 25 km;

Technical note:

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

c. nozzles with thrust levels exceeding 45 kN or nozzle throat erosion rates of less than 0,075 mm/s;

d. movable nozzle or secondary fluid injection thrust vector control systems capable of any of the following:

1. omni-axial movement exceeding ± 5°;

2. angular vector rotations of 20°/s or more; or

3. angular vector accelerations of $40°/s^2$ or more.

9A009 Hybrid rocket propulsion systems with:

N.B.: SEE ALSO 9A109 AND 9A119.

a. total impulse capacity exceeding 1,1 MNs; or

b. thrust levels exceeding 220 kN in vacuum exit conditions.

9A010 Specially designed components, systems and structures for launch vehicles, launch vehicle propulsion systems or ″spacecraft″, as follows:

N.B.: SEE ALSO 1A002 AND 9A110.

a. components and structures each exceeding 10 kg, specially designed for launch vehicles manufactured using metal ″matrix″, ″composite″, organic ″composite″, ceramic ″matrix″ or intermetallic reinforced materials specified in 1C007 or 1C010;

Note: The weight cut-off is not relevant for nose cones.

b. components and structures specially designed for launch vehicle propulsion systems specified in 9A005 to 9A009 manufactured using metal matrix, composite, organic composite, ceramic matrix or intermetallic reinforced materials specified in 1C007 or 1C010;

c. structural components and isolation systems specially designed to control actively the dynamic response or distortion of ″spacecraft″ structures;

d. pulsed liquid rocket engines with thrust-to-weight ratios equal to or more than 1 kN/kg and a response time (the time required to achieve 90 % of total rated thrust from start-up) of less than 30 ms.

9A011 Ramjet, scramjet or combined cycle engines and specially designed components therefor.

N.B.: SEE ALSO 9A111 AND 9A118.

9A012 ″unmanned aerial vehicles″ (″UAVs″), associated systems, equipment and components as follows:

a. ″UAVs″ having any of the following:

1. an autonomous flight control and navigation capability (e.g., an autopilot with an Inertial Navigation System); or

2. capability of controlled-flight out of the direct vision range involving a human operator (e.g., televisual remote control).

b. associated systems, equipment and components as follows:

1. equipment specially designed for remotely controlling the ″UAVs″ specified in 9A012.a.;

2. guidance or control systems, other than those specified in 7A, specially designed for integration into ″UAVs″ specified in 9A012.a.;

3. equipment and components specially designed to convert a manned ″aircraft″ to a ″UAV″ specified in 9A012.a.

9A101 Turbojet and turbofan engines (including turbocompound engines), other than those specified in 9A001, as follows;

a. engines having both of the following characteristics:

1. maximum thrust value greater than 400 N (achieved un-installed) excluding civil certified engines with a maximum thrust value greater than 8 890 N (achieved un-installed), and

2. specific fuel consumption of 0,15 kg/N/hr or less (at maximum continuous power at sea level static and standard conditions);

b. engines designed or modified for use in ″missiles″.

9A104 Sounding rockets, capable of a range of at least 300 km.

N.B.: SEE ALSO 9A004.

9A105 Liquid propellant rocket engines, as follows:

N.B.: SEE ALSO 9A119.

a. liquid propellant rocket engines usable in ″missiles″, other than those specified in 9A005, having a total impulse capacity equal to or greater than 1,1 MNs;

b. liquid propellant rocket engines, usable in complete rocket systems or unmanned aerial vehicles, capable of a range of 300 km, other than those specified in 9A005 or 9A105.a., having a total impulse capacity equal to or greater than 0,841 MNs.

9A106 Systems or components, other than those specified in 9A006, usable in ″missiles″, as follows, specially designed for liquid rocket propulsion systems:

a. ablative liners for thrust or combustion chambers;

b. rocket nozzles;

c. thrust vector control sub systems;

Technical note:

Examples of methods of achieving thrust vector control specified in 9A106.c. are:

1. *flexible nozzle;*

2. *fluid or secondary gas injection;*

3. *movable engine or nozzle;*

4. *deflection of exhaust gas stream (jet vanes or probes); or*

5. *thrust tabs.*

d. liquid and slurry propellant (including oxidisers) control systems, and specially designed components therefor, designed or modified to operate in vibration environments greater than 10 g rms between 20 Hz and 2 kHz.

Note: the only servo valves and pumps specified in 9A106.d., are the following:

a. servo valves designed for flow rates equal to or greater than 24 litres per minute, at an absolute pressure equal to or greater than 7 MPa, that have an actuator response time of less than 100 ms;

b. pumps, for liquid propellants, with shaft speeds equal to or greater than 8 000 r.p.m. or with discharge pressures equal to or greater than 7 MPa.

9A107 Solid propellant rocket engines, usable in complete rocket systems or unmanned aerial vehicles, capable of a range of 300 km, other than those specified in 9A007, having total impulse capacity equal to or greater than 0,841 MNs.

N.B.: SEE ALSO 9A119.

9A108 Components, other than those specified in 9A008, usable in ″missiles″, as follows, specially designed for solid rocket propulsion systems:

a. rocket motor cases and ″insulation″ components therefor;

b. rocket nozzles;

c. thrust vector control sub-systems.

9A108 c. *(continued)*

Technical note:

Examples of methods of achieving thrust vector control specified in 9A108.c. are:

1. *flexible nozzle;*
2. *fluid or secondary gas injection;*
3. *movable engine or nozzle;*
4. *deflection of exhaust gas stream (jet vanes or probes); or*
5. *thrust tabs.*

9A109 Hybrid rocket motors, usable in 'missiles', other than those specified in 9A009, and specially designed components therefor.

N.B.: SEE ALSO 9A119.

Technical note:

In 9A109 'missile' means complete rockets system and unmanned aerial vehicle systems capable of a range exceeding 300 km.

9A110 Composite structures, laminates and manufactures thereof, other than those specified in 9A010, specially designed for use in space launch vehicles specified in 9A004 or sounding rockets specified in 9A104 or the subsystems specified in 9A005, 9A007, 9A105.a., 9A106 to 9A108, 9A116 or 9A119.

N.B.: SEE ALSO 1A002.

9A111 Pulse jet engines, usable in ″missiles″ or unmanned aerial vehicles specified in 9A012, and specially designed components therefor.

N.B.: SEE ALSO 9A011 AND 9A118.

9A115 Launch support equipment as follows:

a. apparatus and devices for handling, control, activation or launching, designed or modified for space launch vehicles specified in 9A004, unmanned aerial vehicles specified in 9A012 or sounding rockets specified in 9A104;

b. vehicles for transport, handling, control, activation or launching, designed or modified for space launch vehicles specified in 9A004 or sounding rockets specified in 9A104.

9A116 Re-entry vehicles, usable in ″missiles″, and equipment designed or modified therefor, as follows:

a. re-entry vehicles;

b. heat shields and components therefor fabricated of ceramic or ablative materials;

c. heat sinks and components therefor fabricated of light-weight, high heat capacity materials;

d. electronic equipment specially designed for re-entry vehicles.

9A117 Staging mechanisms, separation mechanisms, and interstages, usable in ″missiles″.

9A118 Devices to regulate combustion usable in engines, which are usable in ″missiles″ or unmanned aerial vehicles specified in 9A012, specified in 9A011 or 9A111.

9A119 Individual rocket stages, usable in complete rocket systems or unmanned aerial vehicles, capable of a range of 300 km, other than those specified in 9A005, 9A007, 9A009, 9A105, 9A107 and 9A109.

9A120 Liquid propellant tanks, other than those specified in 9A006, specially designed for propellants specified in 1C111 or 'other liquid propellants', used in rocket systems capable of delivering at least a 500 kg payload to a range of at least 300 km.

Note: *in 9A120 'other liquid propellants' includes, but is not limited to, propellants specified in the Military Goods Controls.*

9A350 Spraying or fogging systems, specially designed or modified for fitting to aircraft, "lighter-than-air vehicles" or unmanned aerial vehicles, and specially designed components therefor, as follows:

a. complete spraying or fogging systems capable of delivering, from a liquid suspension, an initial droplet 'VMD' of less than 50 μm at a flow rate of greater than two litres per minute;

b. spray booms or arrays of aerosol generating units capable of delivering, from a liquid suspension, an initial droplet 'VMD' of less than 50 μm at a flow rate of greater than two litres per minute;

c. aerosol generating units specially designed for fitting to systems specified in 9A350.a. and b.

Note: *aerosol generating units are devices specially designed or modified for fitting to aircraft such as nozzles, rotary drum atomisers and similar devices.*

Note: *9A350 does not control spraying or fogging systems and components that are demonstrated not to be capable of delivering biological agents in the form of infectious aerosols.*

Technical notes:

1. *Droplet size for spray equipment or nozzles specially designed for use on aircraft, "lighter-than-air vehicles" or unmanned aerial vehicles should be measured using either of the following:*

   a. doppler laser method;

   b. forward laser diffraction method.

2. *In 9A350 'VMD' means Volume Median Diameter and for water-based systems this equates to Mass Median Diameter (MMD).*

9B Test, Inspection and Production Equipment

9B001 Specially designed equipment, tooling and fixtures, as follows, for manufacturing gas turbine blades, vanes or tip shroud castings:

a. directional solidification or single crystal casting equipment;

b. ceramic cores or shells;

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 9E003.a.

9B003 Equipment specially designed for the ″production″ or test of gas turbine brush seals designed to operate at tip speeds exceeding 335 m/s, and temperatures in excess of 773 K (500 °C), and specially designed components or accessories therefor.

9B004 Tools, dies or fixtures for the solid state joining of ″superalloy″, titanium or intermetallic airfoil-to-disk combinations described in 9E003.a.3. or 9E003.a.6. for gas turbines.

9B005 On-line (real time) control systems, instrumentation (including sensors) or automated data acquisition and processing equipment, specially designed for use with any of the following wind tunnels or devices:

N.B.: SEE ALSO 9B105.

a. wind tunnels designed for speeds of Mach 1,2 or more, except those specially designed for educational purposes and having a 'test section size' (measured laterally) of less than 250 mm;

Technical note:

'Test section size' in 9B005.a. means the diameter of the circle, or the side of the square, or the longest side of the rectangle, at the largest test section location.

b. devices for simulating flow-environments at speeds exceeding Mach 5, including hot-shot tunnels, plasma arc tunnels, shock tubes, shock tunnels, gas tunnels and light gas guns; or

c. wind tunnels or devices, other than two-dimensional sections, capable of simulating Reynolds number flows exceeding 25×10^6.

9B006 Acoustic vibration test equipment capable of producing sound pressure levels of 160 dB or more (referenced to 20 μPa) with a rated output of 4 kW or more at a test cell temperature exceeding 1 273 K (1 000 °C), and specially designed quartz heaters therefor.

N.B.: SEE ALSO 9B106.

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.

9B008 Transducers specially designed for the direct measurement of the wall skin friction of the test flow with a stagnation temperature exceeding 833 K (560 °C).

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 873 K (600 °C) or more.

9B010 Equipment specially designed for the production of ″UAVs″ and associated systems, equipment and components specified in 9A012.

9B105 Wind tunnels for speeds of Mach 0,9 or more, usable for 'missiles' and their subsystems.

N.B.: SEE ALSO 9B005.

Technical note:

In 9B105 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.

9B106 Environmental chambers and anechoic chambers, as follows:

a. environmental chambers capable of simulating the following flight conditions:

1. vibration environments equal to or greater than 10 g rms, measured 'bare table', between 20 Hz and 2 kHz imparting forces equal to or greater than 5 kN; and

2. altitude equal to or greater than 15 km; or

3. temperature range of at least 223 K (– 50 °C) to 398 K (+ 125 °C);

Technical notes:

1. 9B106.a. describes systems that are capable of generating a vibration environment with a single wave (e.g., a sine wave) and systems capable of generating a broad band random vibration (i.e., power spectrum);

2. In 9B106.a.1. 'bare table' means a flat table, or surface with no fixture or fittings.

b. environmental chambers capable of simulating the following flight conditions:

1. acoustic environments at an overall sound pressure level of 140 dB or greater (referenced to 20 μPa) or with a total rated acoustic power output of 4 kW or greater; and

2. altitude equal to or greater than 15 km; or

3. temperature range of at least 223 K (– 50 °C) to 398 K (+ 125 °C).

9B115 Specially designed "production equipment"for the systems, subsystems and components specified in 9A005 to 9A009, 9A011, 9A101, 9A105 to 9A109, 9A111, 9A116 to 9A119.

9B116 Specially designed "production facilities"for the space launch vehicles specified in 9A004, or systems, subsystems, and components specified in 9A005 to 9A009, 9A011, 9A101, 9A104 to 9A109, 9A111, or 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 68 kN of thrust; or

b. capable of simultaneously measuring the three axial thrust components.

9C Materials

9C108 ″Insulation″ material in bulk form and ″interior lining″, other than those specified in 9A008, for rocket motor cases usable in ″missiles″ or specially designed for 'missiles'.

Technical note:

In 9C108 'missile' means complete rocket systems and unmanned aerial vehicle systems capable of a range exceeding 300 km.

9C110 Resin impregnated fibre prepregs and metal coated fibre preforms therefor, for composite structures, laminates and manufactures specified in 9A110, made either with organic matrix or metal matrix utilising fibrous or filamentary reinforcements having a ″specific tensile strength″ greater than $7{,}62 \times 10^4$ m and a ″specific modulus″ greater than $3{,}18 \times 10^6$ m.

N.B.: SEE ALSO 1C010 AND 1C210.

Note: the only resin impregnated fibre prepregs specified in entry 9C110 are those using resins with a glass transition temperature (T_g), after cure, exceeding 418 K (145 °C) as determined by ASTM D4065 or equivalent.

9D Software

9D001 ″Software″ specially designed or modified for the ″development″ of equipment or ″technology″ specified in 9A001 to 9A119, 9B or 9E003.

9D002 ″Software″ specially designed or modified for the ″production″ of equipment specified in 9A001 to 9A119 or 9B.

9D003 ″Software″ specially designed or modified for the ″use″ of ″full authority digital electronic engine controls″ (″FADEC″) for propulsion systems specified in 9A or equipment specified in 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. 2D or 3D viscous ″software″ validated with wind tunnel or flight test data required for detailed engine flow modelling;

b. ″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;

c. ″software″ specially designed to control directional solidification or single crystal casting;

d. ″software″ in ″source code″, ″object code″ or machine code required for the ″use″ of active compensating systems for rotor blade tip clearance control;

Note: *9D004.d. does not control ″software″ embedded in uncontrolled equipment or required for maintenance activities associated with the calibration or repair or updates to the active compensating clearance control system.*

e. ″software″ specially designed or modified for the ″use″ of ″UAVs″ and associated systems, equipment and components specified by 9A012;

f. ″software″ specially designed to design the internal cooling passages of aero gas turbine blades, vans and tip shrouds;

g. ″software″ having all of the following characteristics:

1. being specially designed to predict aero thermal, aeromechanical and combustion conditions in aero gas turbine engines; and

2. having theoretical modelling predictions of the aero thermal, aeromechanical and combustion conditions which have been validated with actual aero gas turbine engine (experimental or production) performance data.

9D101 ″Software″ specially designed or modified for the ″use″ of goods specified in 9B105, 9B106, 9B116 or 9B117.

9D103 ″Software″ specially designed for modelling, simulation or design integration of the space launch vehicles specified in 9A004 or sounding rockets specified in 9A104, or the subsystems specified in 9A005, 9A007, 9A105.a., 9A106, 9A108, 9A116 or 9A119.

9D103 *(continued)*

Note: "Software" specified in 9D103 remains controlled when combined with specially designed hardware specified in 4A102.

9D104 "Software" specially designed or modified for the "use" of goods specified in 9A001, 9A005, 9A006.d., 9A006.g., 9A007.a., 9A008.d., 9A009.a., 9A010.d., 9A011, 9A101, 9A105, 9A106.c., 9A106.d., 9A107, 9A108.c., 9A109, 9A111, 9A115.a., 9A116.d., 9A117 or 9A118.

9D105 "Software"which coordinates the function of more than one subsystem, specially designed or modified for "use" in space launch vehicles specified in 9A004 or sounding rockets specified in 9A104.

9E Technology

Note: "development" or "production", "technology" specified in 9E001 to 9E003 for gas turbine engines remains controlled when used as "use" "technology" for repair, rebuild and overhaul. Excluded from control are: technical data, drawings or documentation for maintenance activities directly associated with calibration, removal or replacement of damaged or unserviceable line replaceable units, including replacement of whole engines or engine modules.

9E001 "Technology" according to the General Technology Note for the "development" of equipment or "software" specified in 9A001.b., 9A004 to 9A012, 9A350, 9B or 9D.

9E002 "Technology" according to the General Technology Note for the "production" of equipment specified in 9A001.b., 9A004 to 9A011, 9A350 or 9B.

N.B.: For "technology" for the repair of controlled structures, laminates or materials, see 1E002.f.

9E003 Other "technology", as follows:

a. "technology" "required" for the "development" or "production" of any of the following gas turbine engine components or systems:

1. gas turbine blades, vanes or tip shrouds made from directionally solidified (DS) or single crystal (SC) alloys having (in the 001 Miller Index Direction) a stress-rupture life exceeding 400 hours at 1 273 K (1 000 °C) at a stress of 200 MPa, based on the average property values;

2. multiple domed combustors operating at average burner outlet temperatures exceeding 1 813 K (1 540 °C) or combustors incorporating thermally decoupled combustion liners, non-metallic liners or non-metallic shells;

3. components manufactured from any of the following:

a. organic "composite" materials designed to operate above 588 K (315 °C);

b. metal "matrix" "composite", ceramic "matrix", intermetallic or intermetallic reinforced materials specified in 1C007; or

c. "composite" material specified in 1C010 and manufactured with resins specified in 1C008.

4. uncooled turbine blades, vanes, tip-shrouds or other components designed to operate at gas path temperatures of 1 323 K (1 050 °C) or more;

5. cooled turbine blades, vanes or tip-shrouds, other than those described in 9E003.a.1., exposed to gas path temperatures of 1 643 K (1 370 °C) or more;

6. airfoil-to-disk blade combinations using solid state joining;

7. gas turbine engine components using "diffusion bonding" "technology" specified in 2E003.b.;

8. damage tolerant gas turbine engine rotating components using powder metallurgy materials specified in 1C002.b.;

9. "FADEC" for gas turbine and combined cycle engines and their related diagnostic components, sensors and specially designed components;

9E003 a. *(continued)*

10. adjustable flow path geometry and associated control systems for:

a. gas generator turbines;

b. fan or power turbines;

c. propelling nozzles;

Note 1: *adjustable flow path geometry and associated control systems in 9E003.a.10. do not include inlet guide vanes, variable pitch fans, variable stators or bleed valves for compressors.*

Note 2: *9E003.a.10. does not control "development" or "production" "technology" for adjustable flow path geometry for reverse thrust.*

11. Hollow fan blades

b. "technology" "required" for the "development" or "production" of any of the following:

1. wind tunnel aero-models equipped with non-intrusive sensors capable of transmitting data from the sensors to the data acquisition system; or

2. "composite" propeller blades or propfans capable of absorbing more than 2 000 kW at flight speeds exceeding Mach 0,55;

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

1. all of the following:

a. depths more than four times their diameter;

b. diameters less than 0,76 mm; and

c. incidence angles equal to or less than 25°; or

2. all of the following:

a. depths more than five times their diameter;

b. diameters less than 0,4 mm; and

c. incidence angles of more than 25°;

Technical note:

For the purposes of 9E003.c., incidence angle is measured from a plane tangential to the airfoil surface at the point where the hole axis enters the airfoil surface.

d. "technology" "required" for the "development" or "production" of helicopter power transfer systems or tilt rotor or tilt wing "aircraft" power transfer systems;

e. "technology" for the "development" or "production" of reciprocating diesel engine ground vehicle propulsion systems having all of the following:

1. a 'box volume' of 1,2 m^3 or less;

2. an overall power output of more than 750 kW based on 80/1269/EEC, ISO 2534 or national equivalents; and

3. a power density of more than 700 kW/m^3 of 'box volume';

9E003 e. *(continued)*

Technical note:

'Box volume' in 9E003.e. 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.

f. ″technology″ ″required″ for the ″production″ of specially designed components, as follows, for high output diesel engines:

1. ″technology″ ″required″ for the ″production″ of engine systems having all of the following components employing ceramics materials specified in 1C007:

a. cylinder liners;

b. pistons;

c. cylinder heads; and

d. one or more other components (including exhaust ports, turbochargers, valve guides, valve assemblies or insulated fuel injectors);

2. ″technology″ ″required″ for the ″production″ of turbocharger systems, with single-stage compressors having all of the following:

a. operating at pressure ratios of 4:1 or higher;

b. a mass flow in the range from 30 to 130 kg per minute; and

c. variable flow area capability within the compressor or turbine sections;

3. ″technology″ ″required″ for the ″production″ of fuel injection systems with a specially designed multifuel (e.g., diesel or jet fuel) capability covering a viscosity range from diesel fuel (2,5 cSt at 310,8 K (37,8 °C)) down to gasoline fuel (0,5 cSt at 310,8 K (37,8 °C)), having both of the following:

a. injection amount in excess of 230 mm^3 per injection per cylinder; and

b. specially designed electronic control features for switching governor characteristics automatically depending on fuel property to provide the same torque characteristics by using the appropriate sensors;

g. ″technology″ ″required″ for the ″development″ or ″production″ of high output diesel engines for solid, gas phase or liquid film (or combinations thereof) cylinder wall lubrication, permitting operation to temperatures exceeding 723 K (450 °C), measured on the cylinder wall at the top limit of travel of the top ring of the piston.

9E003 g. *(continued)*

Technical note:

High output diesel engines: diesel engines with a specified brake mean effective pressure of 1,8 MPa or more at a speed of 2 300 r.p.m., provided the rated speed is 2 300 r.p.m. or more.

9E101 ″Technology″ according to the General Technology Note for the ″development″ or ″production″ of goods specified in 9A101, 9A104 to 9A111 or 9A115 to 9A119.

9E102 ″Technology″ according to the General Technology Note for the ″use″ of space launch vehicles specified in 9A004, or goods specified in 9A005 to 9A011, 9A101, 9A104 to 9A111, 9A115 to 9A119, 9B105, 9B106, 9B115, 9B116, 9B117, 9D101 or 9D103.