

TABLE - DEPOSITION TECHNIQUES

1. Coating Process (1)*	2. Substrate	3. Resultant Coating
D. Plasma spraying (continued)	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)  Carbon-carbon, Ceramic and Metal "matrix" "composites"	Fused silicides Fused aluminides except for resistance heating elements  Silicides Carbides Mixtures thereof (4)
F. Sputter Deposition	"Superalloys"  Ceramics and Low-expansion glasses (14)  Titanium alloys (13)  Carbon-carbon, Ceramic and Metal "matrix" "composites"  Cemented tungsten carbide (16), Silicon carbide  Molybdenum and Molybdenum alloys  Beryllium and Beryllium alloys  Sensor window materials (9)  Refractory metals and alloys (8)	Alloyed silicides Alloyed aluminides (2) Noble metal modified aluminides (3) MCrAlX (5) Modified zirconia (12) Platinum Mixtures thereof (4)  Silicides Platinum Mixtures thereof (4) Dielectric layers (15)  Borides Nitrides Oxides Silicides Aluminides Alloyed aluminides (2) Carbides  Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15)  Carbides Tungsten Mixtures thereof (4) Dielectric layers (15)  Dielectric layers (15)  Borides Dielectric layers (15)  Dielectric layers (15)  Aluminides Silicides Oxides Carbides
G. Ion Implantation	High temperature bearing steels	Additions of Chromium, Tantalum or
Ion Implantation (continued)	Titanium alloys (13)  Beryllium and Beryllium alloys	Niobium (Columbium)  Borides Nitrides  Borides

TABLE - DEPOSITION TECHNIQUES

1. Coating Process (1)*	2. Substrate	3. Resultant Coating
G. Ion Implantation (continued)	Cemented tungsten carbide (16)	Carbides Nitrides

TABLE - DEPOSITION TECHNIQUES - NOTES

- The term 'coating process' includes coating repair and refurbishing as well as original coating.
- 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.
- 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.
- 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.
- 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:
  - 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;
  - 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*
  - 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.
- The term 'Aluminium alloys' refers to alloys having an ultimate tensile strength of 190 MPa or more measured at 293 K (20°C).
- The term 'Corrosion resistant steel' refers to AISI (American Iron and Steel Institute) 300 series or equivalent national standard steels.
- Refractory metals consist of the following metals and their alloys: niobium (columbium), molybdenum, tungsten and tantalum.
- 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 40 mm diameter for thallium bromide and thallium chlorobromide.
- Technology for single-step pack cementation of solid airfoils is not embargoed by Category 1020.
- Polymers, as follows: polyimide, polyester, polysulphide, polycarbonates and polyurethanes.
- 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 embargoed.
- Titanium alloys refers to aerospace alloys having an ultimate tensile strength of 900 MPa or more measured at 293 K (20°C).
- Low-expansion glasses refers to glasses which have a coefficient of thermal expansion of  $1 \times 10^{-7} \text{ K}^{-1}$  or less measured at 293 K (20°C).
- 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.
- 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.  
**Technical Note:**  
Processes specified in Column 1 of the Table are defined as follows:
  - 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