

1061. cont'd.

4. 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<sup>3</sup> 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:**  
1061.4.d.1. does not embargo 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 embargoed by 1061.4.c.1. or 3.;
  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 100 Hz, and either of the following:
    - a. 1. Exceeding 0.15 m but not exceeding 1 m in diameter or major axis length;
    2. Capable of angular accelerations exceeding 2 radians/s<sup>2</sup>; **and**
    3. Having angular pointing errors equal to or less than 200 microradians; or
    - b. 1. Exceeding 1 m in diameter or major axis length;
    2. Capable of angular accelerations exceeding 0.5 radian/s<sup>2</sup>; **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 1 m or more;
- f. "Fluoride fibre" cable, or optical fibres therefor, having an attenuation of less than 4 dB/km in the wavelength range exceeding 1,000 nm but not exceeding 3,000 nm;

5. Lasers

"Lasers", components and optical equipment, as follows:

**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.

3. The embargo 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.
5. a. Gas "lasers", as follows:
  1. Excimer "lasers" having any of the following:
    - a. An output wavelength not exceeding 150 nm **and**:
      1. An output energy exceeding 50 mJ per pulse; **or**
      2. An average or CW output power exceeding 1 W;
    - b. An output wavelength exceeding 150 nm but not exceeding 190 nm **and**:
      1. An output energy exceeding 1.5 J per pulse; **or**
      2. An average or CW output power exceeding 120 W;
    - c. An output wavelength exceeding 190 nm but not exceeding 360 nm **and**:
      1. An output energy exceeding 10 J per pulse; **or**
      2. An average or CW output power exceeding 500 W; **or**
    - d. An output wavelength exceeding 360 nm **and**:
      1. An output energy exceeding 1.5 J per pulse; **or**
      2. An average or CW output power exceeding 30 W;
  2. Metal vapour "lasers", as follows:
    - a. Copper (Cu) "lasers" with an average or CW output power exceeding 20 W;
    - b. Gold (Au) "lasers" with an average or CW output power exceeding 5 W;
    - c. Sodium (Na) "lasers" with an output power exceeding 5 W;
    - d. Barium (Ba) "lasers" with an average or CW output power exceeding 2 W;
  3. Carbon monoxide (CO) "lasers" having either:
    - a. An output energy exceeding 2 J per pulse and a pulsed "peak power" exceeding 5 kW; **or**
    - b. An average or CW output power exceeding 5 kW;
  4. Carbon dioxide (CO<sub>2</sub>) "lasers" having any of the following:
    - a. A CW output power exceeding 10 kW;
    - b. A pulsed output with a "pulse duration" exceeding 10 µs **and**:
      1. An average output power exceeding 10 kW; **or**
      2. A pulsed "peak power" exceeding 100 kW; **or**
    - c. A pulsed output with a "pulse duration" equal to or less than 10 µs **and**:
      1. A pulse energy exceeding 5 J per pulse and "peak power" exceeding 2.5 kW; **or**
      2. An average output power exceeding 2.5 kW;
  5. "Chemical lasers", as follows:
    - a. Hydrogen Fluoride (HF) "lasers";
    - b. Deuterium Fluoride (DF) "lasers";
    - c. "Transfer lasers":
      1. Oxygen Iodine (O<sub>2</sub>-I) "lasers";
      2. Deuterium Fluoride-Carbon dioxide (DF-CO<sub>2</sub>) "lasers";
  6. Gas discharge and ion "lasers", i.e. krypton ion or argon ion "lasers", having either:
    - a. An output energy exceeding 1.5 J per pulse and a pulsed "peak power" exceeding 50 W; **or**
    - b. An average or CW output power exceeding 50 W;
  7. Other gas "lasers", except nitrogen "lasers", having any of the following:
    - a. An output wavelength not exceeding 150 nm **and**:
      1. An output energy exceeding 50 mJ per pulse and a pulsed "peak power" exceeding 1 W; **or**
      2. An average or CW output power exceeding 1 W;
    - b. An output wavelength exceeding 150 nm but not exceeding 800 nm **and**:
      1. An output energy exceeding 1.5 J per pulse and a pulsed "peak power" exceeding 30 W; **or**
      2. An average or CW output power exceeding 30 W;
    - c. An output wavelength exceeding 800 nm but not exceeding 1,400 nm **and**:
      1. An output energy exceeding 0.25 J per pulse and a pulsed "peak power" exceeding 10 W; **or**
      2. An average or CW output power exceeding 10 W; **or**
    - d. An output wavelength exceeding 1,400 nm and an average or CW output power exceeding 1 W;