

- a. Ruby "lasers" having an output energy exceeding 20 J per pulse;
  - b. Neodymium glass "lasers", as follows:
    - 1. "Q-switched lasers" having:
      - a. An output energy exceeding 20 J but not exceeding 50 J per pulse and an average output power exceeding 10 W; or
      - b. An output energy exceeding 50 J per pulse;
    - 2. Non-"Q-switched lasers" having:
      - a. An output energy exceeding 50 J but not exceeding 100 J per pulse and an average output power exceeding 20 W; or
      - b. An output energy exceeding 100 J per pulse;
    - c. Neodymium-doped (other than glass) "lasers", as follows, with an output wavelength exceeding 1,000 nm but not exceeding 1,100 nm:  
(For Neodymium-doped (other than glass) "lasers" having an output wavelength not exceeding 1,000 nm or exceeding 1,100 nm, see 1061.5.c.2.d.)
      - 1. Pulse excited, mode-locked, "Q-switched lasers" with a "pulse duration" of less than 1 ns and:
        - a. A "peak power" exceeding 5 GW;
        - b. An average output power exceeding 10 W; or
        - c. A pulsed energy exceeding 0.1 J;
      - c. 2. Pulse-excited, "Q-switched" lasers, with a pulse duration equal to or more than 1 ns, and:
        - a. A single-transverse mode output with:
          - 1. A "peak power" exceeding 100 MW;
          - 2. An average output power exceeding 20 W; or
          - 3. A pulsed energy exceeding 2 J; or
        - b. A multiple-transverse mode output with:
          - 1. A "peak power" exceeding 200 MW;
          - 2. An average output power exceeding 50 W; or
          - 3. A pulsed energy exceeding 2 J;
      - 3. Pulse-excited, non-"Q-switched lasers", having:
        - a. A single-transverse mode output with:
          - 1. A "peak power" exceeding 500 kW; or
          - 2. An average output power exceeding 150 W; or
        - b. A multiple-transverse mode output with:
          - 1. A "peak power" exceeding 1 MW; or
          - 2. An average power exceeding 500 W;
      - 4. Continuously excited "lasers" having:
        - a. A single-transverse mode output with:
          - 1. A "peak power" exceeding 500 kW; or
          - 2. An average or CW output power exceeding 150 W; or
        - b. A multiple-transverse mode output with:
          - 1. A "peak power" exceeding 1 MW; or
          - 2. An average or CW output power exceeding 500 W;
  - d. Other non-"tunable" "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 30 W; or
      - b. An average or CW output power exceeding 30 W;
    - 3. A wavelength exceeding 800 nm but not exceeding 1,400 nm, as follows:
      - a. "Q-switched lasers" with:
        - 1. An output energy exceeding 0.5 J per pulse and a pulsed "peak power" exceeding 50 W; or
        - 2. An average output power exceeding:
          - a. 10 W for single-mode "lasers";
          - b. 30 W 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 54
        - 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;
1061. 5. 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;
1061. 5. e. Free electron "lasers";
1061. 5. f. 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 embargoed "lasers";
1061. 5. 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;