

NOTE:

Item 4503.10 does not include magnets specially designed for and exported as parts of medical nuclear magnetic resonance (NMR) imaging systems. "As part of" does not prohibit separate shipments from different sources provided the related export documents clearly specify the "part of" relationship.

11. Vacuum pumps with an input throat size of 38 cm (15 in.) or greater with a pumping speed of 15,000 liters/second or greater and capable of producing an ultimate vacuum better than 10^{-4} Torr (0.76×10^{-4} mbar).

TECHNICAL NOTE:

The ultimate vacuum is determined at the input of the pump with the input of the pump blocked off.

12. Direct current high-power supplies capable of continuously producing, over a time period of 8 hours, 100 V or greater with current output of 500 amps or greater and with current or voltage regulation better than 0.1%.
13. High-voltage direct current power supplies capable of continuously producing, over a time period of 8 hours, 20,000 V or greater with current output of 1 amp or greater and with current or voltage regulation better than 0.1%.
4503. 14. Electromagnetic isotope separators, designed for or equipped with, single or multiple ion sources capable of providing a total ion beam current of 50 mA or greater.

NOTES:

1. This entry will control separators capable of enriching stable isotopes as well as those for uranium. A separator capable of separating the isotopes of lead with a one-mass unit difference is inherently capable of enriching the isotopes of uranium with a three-unit mass difference.
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.
3. A single 50-Ma ion source will produce less than 3 g of separated HEU per year from natural abundance feed.

4504. HEAVY WATER PRODUCTION PLANT RELATED EQUIPMENT

4504. 1. Specialized packings for use in separating heavy water from ordinary water, made of phosphor bronze mesh or copper (both chemically treated to improve wettability) and designed for use in vacuum distillation towers.
4504. 2. 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(atm)]; for dilute potassium amide solutions (less than 1%), operating pressure of 20-60 Mpa (200-600 atm); and
- c. a capacity greater than $8.5 \text{ m}^3/\text{h}$ (5 cubic feet per minute).
4504. 3. Water-hydrogen sulfide exchange tray columns constructed from fine carbon steel (such as ASTM A.516) with a diameter of 1.8 m (6 ft.) or greater to operate at a nominal pressure of 2 MPa (300 psi) or greater, except columns which are specially designed or prepared for the production of heavy water. Internal contactors of the columns are segmented trays with an effective assembled diameter of 1.8 m (6 ft.) 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 sulfide/water mixtures, such as 304L or 316 stainless steel.
4504. 4. Hydrogen-cryogenic distillation columns having all of the following applications:
- a. designed to operate with internal temperatures of -238°C (35 K) or less;
- b. designed to operate at 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.

4504. 5. 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.

4505. IMPLOSION SYSTEMS DEVELOPMENT EQUIPMENT

4505. 1. Flash x-ray generators or pulsed electron accelerators with peak energy of 500 keV 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:
- a. 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:
- $$K=1.7 \times 10^3 V^{2.65} Q,$$
- 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 s; if the accelerator beam pulse duration is greater than 1 s, Q is the maximum accelerated charge in 1 s [Q equals the integral of i with respect to t, over the lesser of 1 s or the time duration of the beam pulse ($Q=\int i dt$), where i is beam current in amperes and t is time in seconds] or,
- b. Having an accelerator peak electron energy of 25 MeV or greater and a peak power greater than 50 MW. [Peak power = (peak potential in volts) x (peak beam current in amperes).]

TECHNICAL NOTE:

Time duration of the beam pulse -- In machines, based on microwave accelerating cavities the time duration of the beam pulse is the lesser of 1 s or the duration of the bunched beam packet resulting from one microwave modulator pulse.

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.

4505. 2. Multistage light gas guns or other high-velocity gun systems (coil, electromagnetic, electrothermal, or other advanced systems) capable of accelerating projectiles to 2 km per second or greater.
4505. 3. Mechanical rotating mirror cameras
Mechanical framing cameras with recording rates greater than 225,000 frames per second; streak cameras with writing speeds greater than 0.5 mm per microsecond; and parts, including specially designed synchronizing electronics and specially designed rotor assemblies (consisting of turbines, mirrors, and bearings).
4505. 4. Electronic streak and framing cameras and tubes as follows:
- a. Electronic streak cameras capable of 50 ns or less time resolution and streak tubes therefor;
4505. 4. b. Electronic (or electronically shuttered) framing cameras capable of 50 ns or less frame exposure time;
4505. 4. c. Framing tubes and solid-state imaging devices for use with cameras controlled in sub-item (b) above, as follows:
1. proximity focused image intensifier tubes having the photocathode deposited on a transparent conductive coating to decrease photocathode sheet resistance;
2. gate silicon intensifier target (SIT) vidicon tubes, where a fast system allows gating the photoelectrons from the photocathode before they impinge on the SIT plate;
3. Kerr or pocket cell electro-optical shuttering; or
4. Other framing tubes and solid-state imaging devices having a fast-image gating time of less than 50 ns specially designed for cameras controlled by sub-item (b) above.
4505. 5. Specialized instrumentation for hydrodynamic experiments as follows:
- a. Velocity interferometers for measuring velocities in excess of 1 km per second during time intervals less than 10 s. (VISARs, Doppler laser interferometers, DLIs, etc.);
- b. manganin gauges for pressures greater than 100 kilobars; or
- c. quartz pressure transducers for pressures greater than 100 kilobars.