HRP Training Aid: Valves

DESCRIPTION	ECCN
Austenitic stainless steel plate, valves, piping, tanks, and vessels	**2B999.n**
Bellows seal valves	**2A226**
Bellows seal valves	**2B350.g**
Bellows sealed valves, n.e.s.	**2A999**
Diaphragm valves	**2B350.g**
Double seal valves	**2B350.g**
Flight control servo valves	**7A116.c**
Flight control servo valves	**9A106.e**
Ground vehicles—hydraulic system valves	**0A606.y.10**
Monel equipment including valves, piping, tanks, and vessels	**2B999.f**
Piping, fittings, and valves of or lined with stainless steel, copper–nickel alloy, or other alloy steel	**2A992**
Servo valves, gel propellant control systems	**9A106.d**
Vacuum valves, piping, flanges, gaskets	**2B999.k**
Valves, austenitic stainless steel	**2B999.n**
Valves, bellows seal	**2A226**
Valves, bellows	**2B350.g**
Valves (check) for hydraulic and pneumatic systems in military aircraft	**9A610.y.4**
Valves (check) for military gas turbine engines	**9A619.y.9**
Valves, double-seal	**2B350.g**
Valves, made of or lined with stainless steel, copper–nickel alloy, or other alloy steel (with characteristics not controlled by ECCN 2B350.g)	**2A992**
Valves, diaphragm	**2B350.g**
Valves, Monel	**2B999.f**
Valves, multiple seal incorporating a leak detection port	**2B350.g**
Valves, nonreturn (check)	**2B350.g**
Valves, stainless steel	**2B999.g**
Valves, vacuum	**2B999.k**

Valves – Especially Designed or Prepared (EDP)	**10 CFR Part 110**

KEY NOTES/HELPFUL TIPS

- A valve is a device that regulates, directs, or controls the flow of a fluid (gases, liquids, fluidized solids, or slurries) by opening, closing, or partially obstructing passageways.
- Valves provide two or more fluid connections and a means of opening or closing.
- They are available in a wide variety of configurations, which can vary not only by material of construction and basic valve type but also by the number of fluid ports, types of end connectors, body style, and means of opening and closing (actuation).
- Valves are named using descriptors related to their design and/or function: check, ball, globe, butterfly, swing, gate, plug, needle, flush, relief, diaphragm, bellows seal, and diverter.
- Export controls apply to only a small percentage of the total: specialized valves and valve components meeting certain technical specifications.
- Look for a nameplate or inscription with the manufacturer, model number, and specific unit characteristics.

Types of valves.

Bellows seal valves

ECCN 2A226

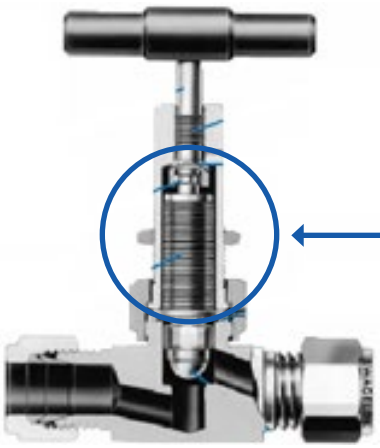
This ECCN controls valves having all of the following characteristics:

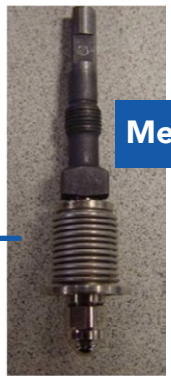
- Nominal size of 5 mm (0.2 in.) or greater
- Having a bellows seal
- Wholly made of or lined with aluminum, aluminum alloy, nickel, or nickel alloy containing >60% nickel by weight

Key Points and Appearance

- For valves with different inlet and outlet diameters, the nominal size refers to the smaller of the inlet and outlet port diameters.
- The valve exterior is typically silver or gray, although it may be painted any color.
  - Stainless steel and other alloy valves are usually unpainted.
  - Cast steel valves may be painted with aluminum paint.
  - Certain ductile iron valves may be painted gray.
- Bellows seal
  - A bellows seal is an internal feature not visible by an external inspection of the valve.
  - The word bellows may or may not appear on the nameplate.
  - Metal bellows are deep corrugated piping, which are flexible and pressure resistant. The bellows expands and contracts as the valve stem moves during the opening and closing process.
  - Bellows form a very reliable leak-free seal without the use of O-rings or gaskets.

Nominal size refers to the smallest diameter.



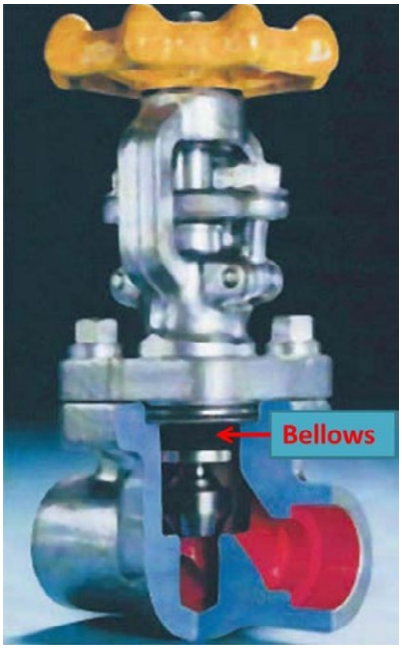


Metal bellows seal.

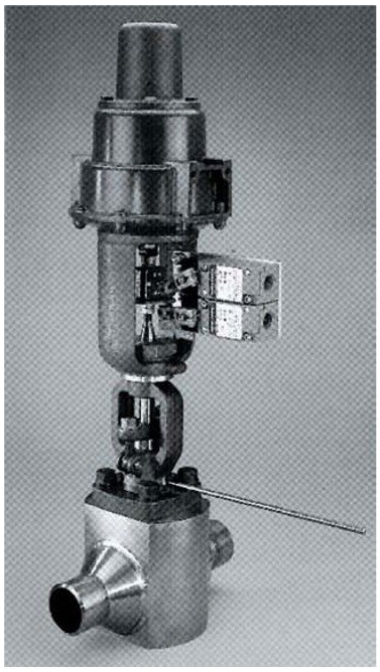
Cross section of bellows seal valve.

Note: Tall valve stems can visually indicate a bellows seal.

A stainless-steel bellows seal globe valve. **Not controlled.**



Cutaway of a globe valve in which the bellows is visible.



A diaphragm-actuated Monel® bellows seal valve with limit switches for UF6 service. Note the optional detection port with a long tube for monitoring and early detection of bellows leakage.

Assorted manual and pneumatically operated bellows seal valves.

Commercial Uses

- Critical applications in the chemical, petrochemical, oil and gas, fossil power, cogeneration, pulp and paper, and cryogenic industries
- Ammonia, benzene, fluorine, chlorine, hydrochloric acid, hydrofluoric acid, hydrogen sulfide, phosgene, liquid sodium, sulfuric acid, and toluene applications

Packaging and Markings

- Small valves are usually packaged in cardboard boxes.
- Large valves are usually in crates or on pallets.
- Both are typically packaged in plastic bags and surrounded by foam padding.

Bellows seal valve packaging

Top box

- Model "SS" denotes stainless steel
- Not controlled

Bottom box

- Model "M" denotes Monel
- Note the RESTRICTED PRODUCT marking
- **Controlled: ECCN 2A226**

Valves for chemical applications

ECCN 2B350.g

g. Valves, as follows:

g.1. Valves having both of the following characteristics:

g.1.a. A nominal size greater than 1.0 cm (3⁄8 in.); and

g.1.b. All surfaces that come in direct contact with the chemical(s) being produced, processed, or contained are made from materials identified in Technical Note 1 to 2B350.g.

g.2. Valves, except for valves controlled by 2B350.g.1, having all of the following characteristics:

g.2.a. A nominal size equal to or greater than 2.54 cm (1 inch) and equal to or less than 10.16 cm (4 inches);

g.2.b. Casings (valve bodies) or preformed casing liners controlled by 2B350.g.3, in which all surfaces that come in direct contact with the chemical(s) being produced, processed, or contained are made from materials identified in Technical Note 1 to 2B350.g; and

g.2.c. A closure element designed to be interchangeable.

g.3. Casings (valve bodies) and preformed casing liners having both of the following characteristics:

g.3.a. Designed for valves in 2B350.g.1 or .g.2; and

g.3.b. All surfaces that come in direct contact with the chemical(s) being produced, processed, or contained are made from materials identified in Technical Note 1 to 2B350.g.

Technical Note 1 to 2B350.g: All surfaces of the valves controlled by 2B350.g.1, and the casings (valve bodies) and preformed casing liners controlled by 2B350.g.3, that come in direct contact with the chemical(s) being produced, processed, or contained are made from the following materials:

a. Alloys with more than 25% nickel and 20% chromium by weight
b. Nickel or alloys with more than 40% nickel by weight
c. Fluoropolymers (polymeric or elastomeric materials with more than 35% fluorine by weight)
d. Glass (including vitrified or enameled coating or glass lining)
e. Tantalum or tantalum alloys
f. Titanium or titanium alloys
g. Zirconium or zirconium alloys
h. Niobium (columbium) or niobium alloys; or
i. Ceramic materials, as follows:
i.1. Silicon carbide with a purity of 80% or more by weight;
i.2. Aluminum oxide (alumina) with a purity of 99.9% or more by weight; or
i.3. Zirconium oxide (zirconia)

Key Points and Appearance

- A variety of valves and seals, including bellows seal valves are used for chemical weapons production.
- Types: butterfly valves, check valves, diaphragm valves
- Can be operated manually, electrically or pneumatically
- Look for the following:
  - Nominal size greater than 1.0 cm (3/8 in.)
  - All fluid contact surfaces are corrosion resistant materials
    - **Metal alloys**: Look for trade names like Hastelloy, Monel, and Inconel
    - **Fluoropolymers**: Look like plastics and are often known by trade names like Teflon and Kynar, or by acronyms like PVDF, PTFE, and PFA
    - **Glass** lining: Will often look like a white or blue enamel coating
  - The valve body could be plastic or metal. It is also possible for the entire valve to be constructed from a fluoropolymer material.
- **Valve casings** (also known as valve bodies) and **preformed casing liners** for controlled valves are also controlled as separate items if they are made of certain corrosion-resistant materials.

Fluoropolymer lined valve for chemicals production

Fluoropolymer butterfly valve

Stamp on a valve made of Hastelloy C-276 (a high nickel alloy with >40% nickel by weight).

Fluoropolymer lining.

Preformed casing liners.

Glass-lined steel.

A. Fluoropolymer-lined plug valves with different actuation mechanisms (manual, pneumatic, and electrical)

B. Fluoropolymer-lined, manually actuated butterfly valve

C. Fluoropolymer check valve (automatic actuation)

D. Zirconium check valve (automatic actuation)

E. Wholly fluoropolymer, three-port manual diaphragm valves

Valves for (missile) delivery systems applications

Flight control servo valves ECCN 7A116.c

This ECCN controls flight control systems, parts, and components, including item c below:

> c. Flight control servo valves designed [or] modified for the systems in 7A116.a. or 7A116.b and designed or modified to operate in a vibration environment greater than 10 g rms over the entire range between 20 Hz and 2 kHz.

Note: This entry includes the systems, equipment, and valves designed or modified to enable operation of manned aircraft as unmanned aerial vehicles.

Servo valves, gel propellant control systems ECCN 9A106.d

This ECCN controls systems, parts, or components usable in missiles and "specially designed" for liquid rocket propulsion systems, including item d below:

> d. Liquid, slurry, and gel propellant (including oxidizers) control systems, and "specially designed" parts and components, designed or modified to operate in vibration environments greater than 10 g rms between 20 Hz and 2,000 Hz

Note: 9A106.d only controls servo valves designed for flow rates equal to or greater than 24 liters per minute, at an absolute pressure equal to or greater than 7 MPa, that have an actuator response time of less than 100 ms.

Flight control servo valves ECCN 9A106.e

This ECCN controls systems, parts, or components usable in missiles, and "specially designed" for liquid rocket propulsion systems, including item e below:

> e. Flight control servo valves designed or modified for use in missiles and designed or modified to operate in a vibration environment greater than 10 g rms over the entire range between 20 Hz and 2 kHz.

Servo Valves: Key Points and Features

- Used to control the speed of turbopumps which feed liquid, slurry, and gel propellants into rocket engines → missile propulsion applications

- Used in rockets and UAVs to control hydraulic actuators linked to primary flight control surfaces and thrust vector control (TVC) systems → missile guidance applications
- Servo valves must operate under high vibration conditions
- Flow rates of 24 liters per minute or greater
- Pressure of 7 MPa (1,000 psi) or greater
- Fast actuator response time of less than 100 ms
- Electrically controlled and part of a computer controlled system

Commercial Uses

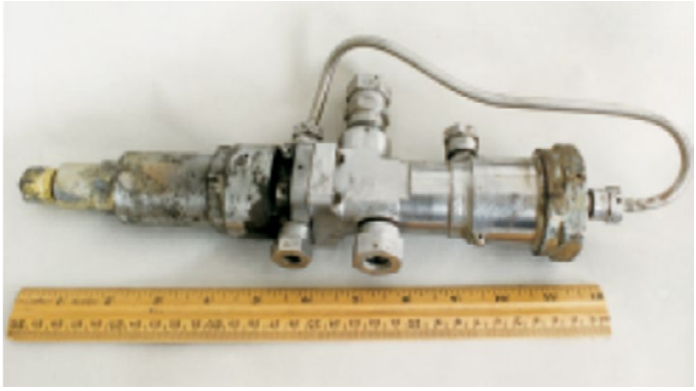
- Liquid propellant control systems for space launch vehicles and sounding rockets
- Flight control systems in rockets, UAVs and manned aircraft
- Chemical handling systems
- Turbine drill pumps for the petroleum industry

Appearance/Look for the following

- Multiple fluid connections for pneumatic or hydraulic lines
- A linear or rotary mechanical actuator
- Rugged construction
- Electrical connections

Electro-hydraulic fuel metering servo valve. Note the electrical connection front and center.

Liquid propellant control valve. Note the multiple ports.



Hydraulic servo valve from a SCUD missile.

Hydraulic flight control linear actuator.

Servo valve for delivery systems.

Other Valve Controls (non-Weapons of Mass Destruction)

Hydraulic system valves for ground vehicles — ECCN 0A606.y.10

ECCN 0A606 controls ground vehicles and related commodities, including item y.10 below:

y.10. Hydraulic system hoses, fittings, couplings, adapters, and valves

Pipe valves — ECCN 2A992

This ECCN controls fittings and valves made of, or lined with stainless, copper-nickel alloy or other alloy steel containing 10% or more nickel and/or chromium, including item b below, for anti-terrorism (AT) reasons:

b. **Pipe valves** having all of the following characteristics that are not controlled by ECCN 2B350.g:

b.1. A pipe size connection of 200 mm (8 in.) or more inside diameter; and

b.2. Rated at 10.3 MPa (1,500 psi) or more

Bellows sealed valves to North Korea — ECCN 2A999

This ECCN controls specific processing equipment not elsewhere specified (n.e.s.) to North Korea for anti-terrorism (AT) reasons, including item a below:

a. Bellows sealed valves

Monel, stainless steel, and vacuum valves to North Korea — ECCN 2B999

This ECCN controls specific processing equipment n.e.s. to North Korea for anti-terrorism (AT) reasons, including items f, g, k, and n below:

f. Monel equipment, including valves, piping, tanks, and vessels
g. 304 and 316 stainless steel valves, piping, tanks, and vessels
k. Vacuum valves, piping, flanges, gaskets, and related equipment "specially designed" for use in high-vacuum service, n.e.s.
n. Austenitic stainless steel plate, valves, piping, tanks, and vessels

Valves (check) for hydraulic and pneumatic systems in military aircraft — ECCN 9A610.y.4

ECCN 9A610 controls military aircraft and specific parts and components "specially designed" for a military use, including item y.4 below:

y.4. Check valves for hydraulic and pneumatic systems

Note: Check valves are directional control devices that permit flow in one direction only.

Hydraulic check valve used on F-4, B-52, KC-135, C-130 and various naval applications.

Valves (check) for military gas turbine engines

ECCN 9A619.y.9

ECCN 9A619 controls military gas turbine engines and related commodities, including item y.9 below:

y.9. Check valves for fluid systems

JASC liquid fuel check valve

- Construction Material: Stainless steel

Major U.S. Valve Manufacturers

- AMRI Inc. (Houston, TX): www.amresist.com
- Asahi America (Malden, MA): www.asahi-america.com
- Chem Flowtronics (Little Falls, NJ): www.chemflowtronics.com
- Entegris Inc. (Chaska, MN): www.entegris.com
- Estrella USA (Lansdale, PA): www.estrella-usa.com
- Flowserve Corporation (Irving, TX): www.flowserve.com
- Plast-O-Matic Valves Inc. (Cedar Grove, NJ): www.plastomatic.com
- Simtech USA (Leavittown, PA): www.simtechusa.com
- Special Metals Inc. (Conroe, TX): tantalumfabricators.com
- Stemmerich Inc. (St. Louis, MO): www.stemmerich.com
- Swagelok (Solon, OH): www.swagelok.com
- Tenn-Plast Inc. (Memphis, TN): www.tenn-plast.com
- Teqcom Industries Inc. (Santa Ana, CA): www.ipolymer.com
- Hoke (Spartanburg, SC): www.hoke.com

Valves Especially Designed or Prepared (EDP)

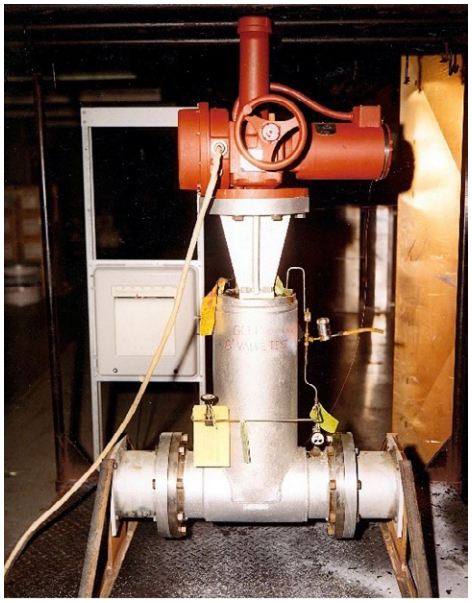
10 CFR Part 110

Valves especially designed or prepared (EDP) for the processing, use, or production of special fissionable material (e.g., plutonium-239, uranium-233, uranium-235 enriched in the isotopes 235 or 233) are subject to the export licensing authority of the U.S. Nuclear Regulatory Commission (see 10 CFR Part 110).

Examples
Valves Modified (i.e., "Especially Prepared") for UF_6 Service

Hoke valve "especially prepared" for UF_6 service. Note flanged piping connections. EDP (10 CFR Part 110).

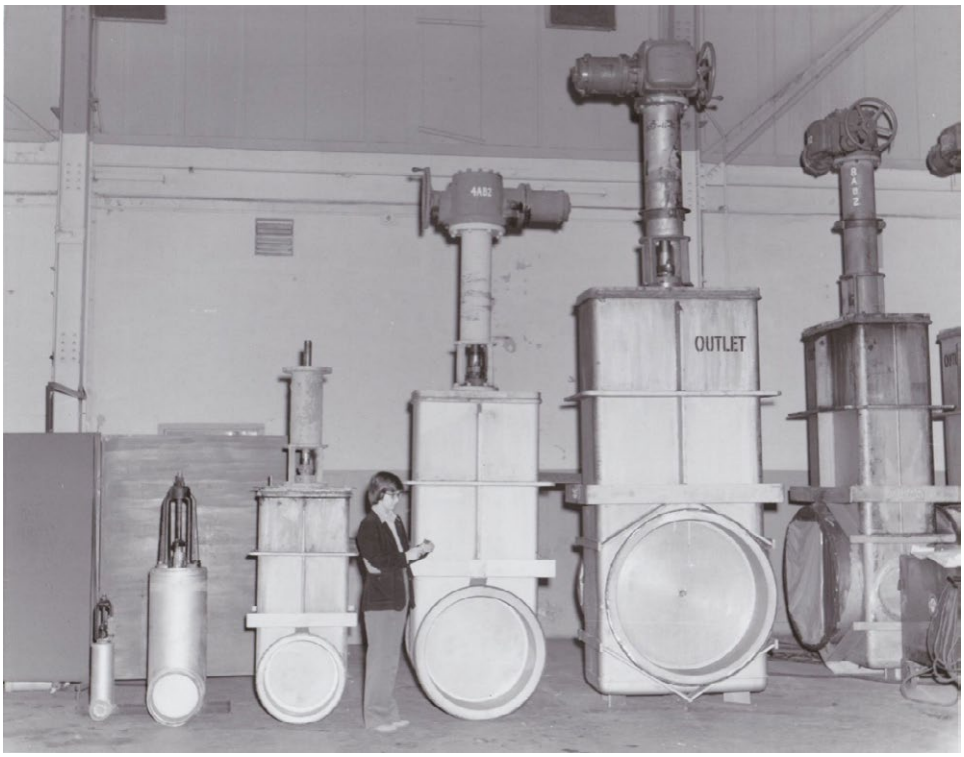
Standard Hoke bellows seal valve (not modified). Dual-use (ECCN 2A226).



Motor-operated bellows seal gate valve for UF_6 service

- Can be operated electrically or manually
- **EDP (10 CFR 110)**

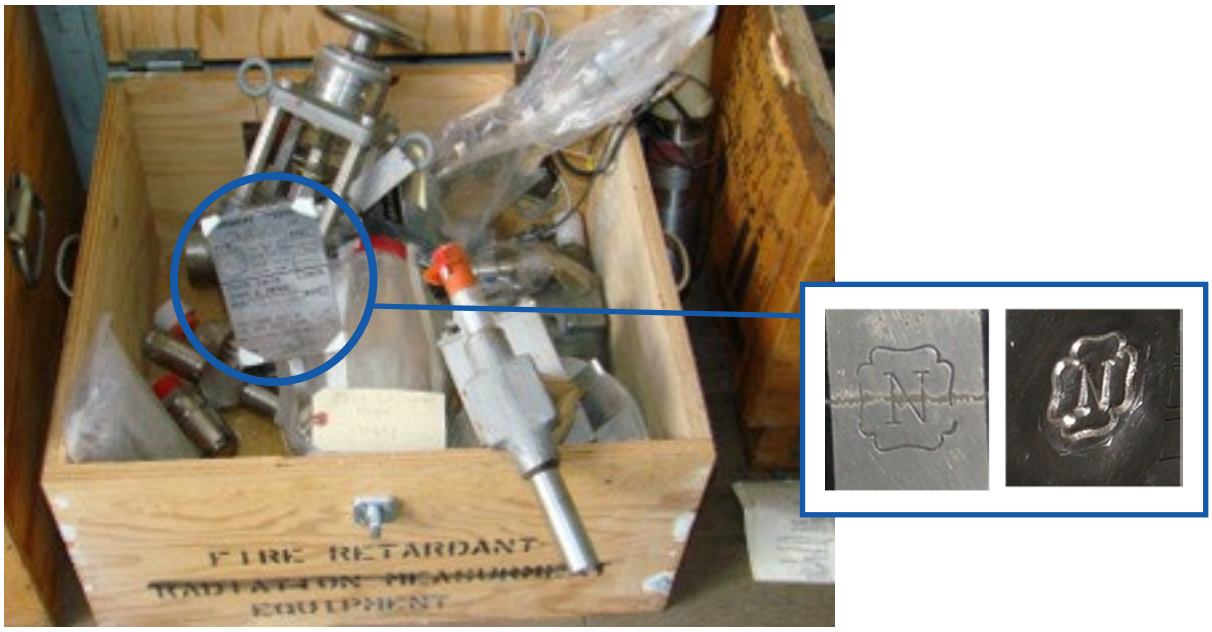
Valves EDP for Uranium Enrichment Processes



Motor-operated gate valves EDP for use in a gaseous diffusion plant. Note the range of valve sizes.

Valves EDP for Nuclear Reactors

Some EDP valves may include certifications and visible markings such as an American Society of Mechanical Engineers (ASME) N stamp.



ASME N-type Certificates for Nuclear Components

	Old Format	New Format
• Nuclear vessels, pumps, valves, piping systems, storage tanks, core support structures, concrete containments, spent fuel containments and high level waste containments	N	N
• Field installation and shop assembly	NA	NA
• Fabrication, with or without design responsibility, of tubular products with filler metal, parts, appurtenances and piping subassemblies, for nuclear appurtenances and supports	NPT	NPT
• Pressure relief valves	NV	NV
• Containments for spent nuclear fuel and high level radioactive waste	N3	N3

Globe valves EDP for a boiling water reactor.

Large gate valve EDP for a boiling water reactor (BWR)