

EQUIPMENT GUIDE / FLOW CONTROL

Valve Material Selection Guide

Which valve architecture and wetted material hold up against your actual chemical, at your actual concentration and temperature — not the generic catalog answer.

THE PROBLEM THIS GUIDE SOLVES

Most valve failures are seat and seal failures, not body failures

A valve rated for "chemical service" is not a specification. Body, seat/seal, and liner material are three separate compatibility questions – vendor data here repeatedly shows 316 stainless steel losing to thermoplastics (PVDF, PTFE, PFA) on chemistries that look benign, while a body-only rating hides a seat or diaphragm that fails first.

This guide organizes real, vendor-documented compatibility data by valve architecture, not by brand. Every material call-out is sourced to a named vendor document or the LibertyCES chemical-compatibility chart.

ARCHITECTURE SELECTION, AT A GLANCE

Flow-control architectures, by what they're actually built to isolate or control

Architecture family	Built for	Watch for
Ball Valve (incl. thermoplastic, chlorine-service, cryogenic, Vee-port)	Tight shutoff, quarter-turn isolation, general chemical service	Vented-ball designs required for off-gassing chemicals (NaOCl, chlorine) – a sealed ball traps pressure
Butterfly Valve (incl. high-performance, thermoplastic, cryogenic)	Large-diameter isolation and throttling, wide temperature range via seat swap alone	Seat material, not body, sets the real temperature/chemical ceiling – same body spans -196°C to +550°C
Plug Valve (incl. sleeved, jacketed)	Cavity-free service on crystallizing/fouling media, fugitive-emissions-critical toxic gas duty	Sleeve polymer is rarely named by the vendor – verify by spec review, not by catalog page
Diaphragm Valve	Bubble-tight shutoff on slurries and suspended-solids service a ball valve's seat pocket would pack with solids	Diaphragm elastomer is the real spec axis and can behave non-monotonically with concentration and temperature
Check Valve	Backflow prevention in corrosive or hygienic lines	Spring material (Hastelloy option) matters as much as the lining for aggressive oxidizer service
Actuated Valve / Actuator	Automated dosing and remote isolation	The diaphragm or seal inside an actuated valve is frequently the limiting material, not the actuator housing
Air Valve / Air Release / Combination Air Valve	Air and vacuum management in liquid lines, including scaling leach solutions	Continuous air-gap designs prevent scale fouling that a direct float seal would suffer
Knife Gate Valve	Solids-laden slurry and byproduct isolation	No 3-A/FDA certification in this dataset – treat as utility/byproduct duty, not product-contact
Thermoplastic Metal-Replacement Valve Set	Direct swap-in for corroding metal valves on plating, photographic, and mixed-acid/caustic process lines	ISO 5752 short-pattern face-to-face makes this a drop-in retrofit, not a redesign
PFA/PTFE-Lined Valve & Sight Glass	Visual/process confirmation and isolation where 316SS is the weak material in the line, not the strong one	The lined valve family is frequently the only equipment in a line rated for refrigerants and other "benign-looking" fluids that corrode stainless

BALL VALVE — EVIDENCE: STRONG

Acids, oxidizers & caustics



Crane CPE/XOMOX XLB Lined Ball Valve

Also confirmed: Asahi Type-21/21a · Hayward TBH/TBH-Z · Richter BVA/KA-N/KK/KN/KNR

Hydrochloric Acid

Sulfuric Acid

Nitric Acid

Hydrofluoric Acid

Peracetic Acid (40%)

Hayward's own 20-chemical × 12-material compatibility table gives quantified A/B/C/X ratings per acid. PFA is rated Excellent across the board; CPVC is weak specifically on hydrofluoric acid, and 316SS underperforms on both HCl and HF. Peracetic acid at 40% is the most restrictive single chemical in the table — only PTFE and PVDF pass.

Material flag, off-gassing chemicals: for sodium hypochlorite, chlorine, and bromine, Hayward's own tracking documents this as the twelfth cross-vendor confirmation of the same pattern — PVDF/PP/CPVC rate Excellent, but EPDM derates from B to C when fully exposed, and 316SS rates poor. The fix is a drilled/vented ball (Hayward TBH-Z, AVCO Chlorine Service Ball Valve, Asahi Type-21 vented ball, Crane XLB) that relieves the pressure an off-gassing chemical builds inside a sealed ball — not a stronger material alone.

Caustics/bases (sodium hydroxide) — Hayward's chemfeed resistance table rates most thermoplastics "A," and Ultem GF40% also rates Excellent, giving a premium option above PVDF/PP/CPVC where needed.

Salts/brines — evidence: moderate. Crane's own 8-chemical reference table names brine and sea water explicitly for the XLB; PFA lining is the confirmed material, with 316SS flagged for chloride pitting risk. Netafim's own ball valves are also field-confirmed in heap-leach brine service.

BUTTERFLY VALVE — EVIDENCE: STRONG

Acids, caustics & off-gassing chemicals



Crane CPE/XOMOX Type 800 / Special Purpose Butterfly Valve

Also: [Crane Type 800ISO](#) · [Asahi Type-57 series](#) · [AVCO BFV HP](#)

Hydrofluoric Acid

Sulfuric Acid

Hot Acids

Sodium Hydroxide

HF acid and sodium hydroxide are both explicitly named on this line, with a metal/graphite seat (Type 800ISO) rated -70°C to 550°C or a PTFE/PCTFE seat as the confirmed material options; 316SS is flagged weak against HF specifically. Sodium hydroxide compatibility here fills a real intra-brand gap — it does not appear on Crane's Lined Butterfly Valve (XLD) chemical list.

Off-gassing chemicals: Asahi's Type-14/57 line uses a 3-layer EPDM/PVDF/PTFE diaphragm engineered specifically to block gas permeation from sodium hypochlorite off-gassing, and Crane's Type 800 has a dedicated dry-chlorine-liquefaction application — the same vented/barrier-layer principle established for ball valves above, applied to the butterfly architecture.

Salts/brines — evidence: moderate. Trona slurry, sodium carbonate, and recausticizing liquor are named among Type 800's mining and pulp-and-paper applications, using a metal/graphite seat.

Solvents/organics — evidence: moderate. Methanol, chloroform, and chlorpyridine are named among Type 800's chemical/petrochemical applications, with a PTFE/PCTFE seat as the confirmed material.

| PLUG VALVE / SLEEVED PLUG VALVE – EVIDENCE: STRONG

HF acid, wet chlorine gas & fugitive-emissions-critical service



Crane CPE/XOMOX Sleeved Plug Valve family

HF4D / Tertiary Top Seal (Hydrofluoric) · FE0 (<20ppm fugitive emissions) · XP3 · SSV · Jacketed · L-TORQ · Barstock · Double Block and Bleed · Full Port

Hydrofluoric Acid

Wet Chlorine Gas

Sodium Hydroxide

Phosgene

Hydrogen Cyanide

HF service: the Low Emission HF4D and Tertiary Top Seal variants are design-listed and endorsed by UOP and ConocoPhillips for HF Alkylation Units — a named-customer endorsement found nowhere else in this vendor's catalog. HF4D adds a fourth sealing barrier and an HF Detection Paint option; sleeve materials themselves are not disclosed by the vendor on any of the 21 product pages and should be confirmed by spec review.

Toxic gas / fugitive-emissions service: for phosgene, hydrogen cyanide, dry chlorine, and hydrofluoric acid derivatives, FE0 is certified below 20ppm (AH class), HF4D and SR meet API 641 with zero packing adjustments across thermal cycles, XP3 holds across four thermal cycles, and SSV carries EPA Method 21. For a toxic gas, the stem leak rate is the engineering problem — not the body material.

Caustics/bases (sodium hydroxide): a cavity-free sleeve design is repeated across all 20 sleeved-plug products specifically to avoid crystallizing media like NaOH — the design principle, not a single named material, is the compatibility answer here.

Oxidizers/disinfectants: wet chlorine gas and hypochlorites are explicitly named for the chlor-alkali industry, with titanium, zirconium, and tantalum available as upgrade options above the carbon-steel/CF8M/nickel-alloy baseline.

Solvents/organics — evidence: strong. Methanol, benzene, toluene, vinyl chloride monomer (VCM), ethylene oxide/glycol, and butadiene are named explicitly for petrochemical/aromatics service, with nickel alloys and titanium confirmed for the more aggressive organics.

Jacketed model — food and temperature-sensitive media: full or partial heating jackets keep temperature-sensitive media (bitumen, tail gas, glue, and — per the vendor's own media list — "Food") from solidifying in the valve. Coffee appears explicitly in the L-TORQ chemistry list; pair with Special Purpose Butterfly's Steam Peelers/Hot Vegetable applications and Type 800's Corn processing branch for a complete hot-food-processing story.

Salts/brines — evidence: light. Calcium chloride is explicitly listed among named sleeved-plug-valve chemistries, with nickel alloys as the confirmed material.

CHECK VALVE — EVIDENCE: MODERATE

Backflow prevention in corrosive lines



Crane CPE/XOMOX XLC Lined Check Valve

Also: Richter BC/CV/GR/RV/SR · Hayward WCV/YC/TC/IV/IQ

Sulfuric Acid

Nitric Acid

Hydrochloric Acid

Phosphoric Acid

The same 8-chemical shared reference table used across Crane's lined valve family confirms this acid list, with a PFA/PTFE lining over a ductile-iron body. For oxidizer service (chlorine, sodium hypochlorite per Hayward's chemfeed table), Hayward's IV/IQ series offers a Hastelloy C spring option specifically for aggressive oxidizers — the spring, not just the lining, needs to be spec'd for this service.

Salts/brines — evidence: moderate. Brine and sea water appear in Crane's shared 8-chemical table with PFA lining confirmed. **Solvents/organics — evidence: light.** Benzene is named in the same shared reference table.

ACTUATED VALVE — EVIDENCE: STRONG

Automated dosing & heap-leach control



Netafim 75/90/100 Series diaphragm-actuated valves

Also: GF Signet actuated valves (pH-controlled dosing)

Chlorine Gas

Chlorine Dioxide

Sodium Hypochlorite

Sulfuric Acid

Material flag: Netafim's ALD70 diaphragm chemical-resistance chart gives hard fail ratings for chlorine gas, chlorine dioxide, and sodium hypochlorite — a Hastelloy upgrade is required for that service. On sulfuric acid, the same ALD70 diaphragm is rated to only 38°C maximum and fails outright on nitric acid, even though the valve body material may tolerate higher temperatures. The diaphragm, not the body, is the limiting material on this architecture.

Caustics/bases — evidence: moderate. GF Signet's application guide ties actuated-valve dosing directly to sodium hydroxide injection with explicit pH setpoint targets for a cyanide-destruction batch process, using PVC/nylon wetted parts.

Salts/brines — evidence: moderate. A real dual-chemistry temperature rating — raffinate solution at 110°F and barren cyanide solution at 100°F — confirms service across both major heap-leach chemistries on the ALD70 diaphragm / SST 316 configuration.

Air & vacuum management in scaling leach solutions



Netafim D20 / D25 / D26 / D40 / D40L Air Valve Series

Sulfuric Acid (heap leach)

Barren Cyanide Solution

Raffinate

The D20/D25/D26 continuous air-gap design — a conical, funnel-shaped lower body — physically separates leach solution from the sealing mechanism, so scale and mineral deposits can't foul the seal the way they would on a conventional direct float-seal air valve. Confirmed wetted materials include reinforced nylon, polypropylene, PVDF, 316 stainless, super duplex, and Hastelloy springs, used across both copper SX/EW and gold/silver cyanide heap-leach circuits.

ACTUATOR — EVIDENCE: LIGHT

Actuator housings themselves are rarely chemical-rated directly. Asahi's Series 92/94 Electric Actuator and Crane CPE's MATRYX/XRP Pneumatic Actuator are documented against a generic "Chemical Applications" sector and oilfield service context rather than a specific named acid or base — treat actuator housing material (aluminum alloy, Rilsan-coated aluminum, glass-filled polyamide, or 316SS) as a spec-review item tied to the wetted valve it drives, not a standalone chemical rating.

HIGH PERFORMANCE BUTTERFLY VALVE — EVIDENCE: STRONG

Hydrocarbons, dry chlorine & cryogenic gases



XOMOX Type 800 / Type 800ISO

Also: XeniTh Extended Temperature · HPBV-STJ Steam Traced Jacketed · Cryogenic Butterfly Valves

Dry Chlorine

Liquid Nitrogen

Oxygen

Hydrofluoric Acid

Sodium Hydroxide

The seat-material ladder is the real spec content here: the same body spans -196°C to $+550^{\circ}\text{C}$ purely by changing seat construction — the widest single-family range in this dataset. PTFE/RPTFE covers -70°C to $+232^{\circ}\text{C}$, Metal-PEEK extends to $+260^{\circ}\text{C}$, Fire-Safe Metal/PTFE to $+300^{\circ}\text{C}$, and Metal/Graphite reaches $+550^{\circ}\text{C}$ (1022°F), the highest single-valve temperature ceiling documented across this entire equipment catalog. A dedicated dry-chlorine-service datasheet (CP-XOMOX-HPBVDRYCHLORINESERVICE) validates this line for chlorine gas handling rather than merely marketing it for that service.

Material flag: the LibertyCES compatibility chart independently confirms 316SS rates only "C" on wet fluorine gas and bromine media, and "G" on dry hydrogen sulfide, sulfur chloride, phosphorus trichloride, and carbon disulfide — the same alloys/Hastelloy/Duplex upgrade path used for ball and plug valves applies here.

Sodium hydroxide is explicitly named on this line and notably was *not* listed on XOMOX's Lined Valve (XLB/XLC/XLD) family — this fills a real intra-brand gap for a caustic-service butterfly valve.

Steam-traced jacketed variant (HPBV-STJ): triple-point steam jacketing — shaft/bearings, body, and disc all jacketed, with steam circulating through the full disc perimeter — is the anti-solidification answer for waxy or asphaltic hydrocarbon media, the same "keep it hot enough to keep it liquid" principle as the Jacketed Sleeved Plug Valve on page 3.

CRYOGENIC BALL VALVE / CHLORINE SERVICE BALL VALVE — EVIDENCE: STRONG

LNG, natural gas & Chlorine Institute Pamphlet 6 compliance



AVCO 1500 / 9500 / 11500 / 19500 Series Cryogenic Ball Valve

Also: [AVCO Chlorine Service Ball Valve \(1100/1900 platform\)](#)

LNG

Natural Gas

Propane

Chlorine Gas

Bromine Vapor

The 1500 Series' double-seal design — sealed both at the top of the valve and the top of the bonnet, via a Flexitallic spiral-wound gasket — is what makes its single-piece cryogenic bonnet extension trustworthy rather than just longer. Hastelloy C and Monel 400 are confirmed body/ball/stem options; the 9500/11500/19500 variants extend the same cryogenic bonnet principle to trunnion-mount platforms up to 6" and to subterranean box installations.

Chlorine Service Ball Valve — the most chemistry-specific product in this dataset:

compliant with Chlorine Institute Pamphlet 6, appropriate for Chlorine Service Classes I & IV, using Monel 400 or Hastelloy C ball/stem/retainers over a carbon-steel WCB body. The vented-ball pressure-relief mechanism — the same off-gassing pattern established for sodium hypochlorite on page 2 — is applied here specifically to chlorine. The compatibility chart independently supports this specification: 316SS rates only "C" against bromine vapor 25%, saturated bromine water, wet fluorine gas, and aqua regia, while PVDF and PTFE rate "Excellent."

DIAPHRAGM VALVE — EVIDENCE: MODERATE

Bubble-tight shutoff on slurries a ball valve's seat pocket would pack



Asahi/America Type-14 Flanged & True Union Diaphragm Valve

Also: Richter MV/MVP PFA-lined diaphragm valve

Lime Slurry / Ca(OH)_2

Sodium Hydroxide 50%

Aqueous Ammonia 19%

The Type-14's weir design is specifically stated to seal bubble-tight even with slurries and suspended particles — the requirement in a lime-feed line where a ball valve's seat pocket packs with hardened calcium hydroxide. Evidence is moderate because no vendor names lime slurry for a diaphragm valve directly; the caustics pairing data (EPDM diaphragm confirmed for 50% NaOH and 19% aqueous ammonia) is real and concentration-specific, while the lime-slurry application itself is inferred from the corpus rather than named outright.

Non-monotonic caustic behavior: Netafim's ALD70 diaphragm caustic-soda ratings are the only concentration-*and*-temperature-resolved caustic diaphragm data in this dataset, and the pattern is genuinely non-monotonic — Limit at 15-50% @70°C, Limit at 70% @38°C, but Good at 5% @50°C and Good at both 50% and 70% @100°C. Concentration and temperature have to be checked together, not separately.

THERMOPLASTIC METAL-REPLACEMENT VALVE SET — EVIDENCE: STRONG

Plating & photographic process solutions



Asahi/America Type-57 LIS Butterfly · Type-55 IS Butterfly · Type-14 Diaphragm · Type P Gate · Wafer Check

Chromic Acid 10–50%

Plating Solutions (Ni, Sn, Ag)

Sodium/Potassium Cyanide

Photographic Solutions

This is the cleanest single argument in this dataset, and the compatibility chart makes it directly: 316 stainless rates "C" or "F" against most plating chemistries, while PVC, PP, PVDF, PFA, and PTFE all rate "Excellent." Plating is precisely where thermoplastic valves beat metal valves on chemistry, not just on price. Asahi names electroplating and printing among its served industries, and names plating solutions, wet chlorine, acidic waste, sulfuric/hydrofluoric/nitric acid, oxidizers, caustics, solvents, and halogens as the process chemistries this five-valve set is built for.

Material flag: across this family, 316SS rates "F" (poor) on plating solutions for nickel and tin, nickel chloride, silver nitrate, zinc sulfate, and potassium bichromate; "C" on chromic acid at every concentration from 10–50% and on stannic chloride. PVC per ASTM D1784 CC 12454-A, PP, PVDF, and PTFE are the confirmed replacement materials, all rated "Excellent" on the same chemistries.

ISO 5752 short-pattern face-to-face dimensions make this a drop-in retrofit when an existing metal valve corrodes out — not a redesign of the line. Photographic process solutions are grouped here because they are silver-bearing spent solutions with the same metals-recovery and discharge-control problem as plating; the chart rates them "Excellent" across PVC/PP/PVDF/PFA/316SS at 40°C, including sodium thiosulfate fixer chemistry. All five valve types in this set carry a 3-year warranty.

PFA/PTFE-LINED VALVE & SIGHT GLASS — EVIDENCE: MODERATE

Where 316SS is the weak material, not the strong one



Richter PSG/F, TSG/F, SGS/F Sight Glasses · MV/MVP Diaphragm Valve · PA/F Sampling Valve · BAV/BAVM Bottom Drain Valve

Refrigerants (Freon-11/12/21/22/113/114)

Creosote

Tall Oil

The specific finding a fluoropolymer-lined equipment page should lead with: across all six refrigerants in the compatibility chart, PVDF, PFA, and PTFE all rate "Excellent," while 316 stainless drops to "Fair" — the only chemical family in the full chart where stainless is the weakest listed wetted material against an otherwise benign-looking fluid. The same pattern, less severe, appears on creosote and tall oil, where 316SS rates only "Good" at both 40°C and 80°C. Evidence is moderate because no vendor page in this dataset names Freon service directly — the material conclusion comes from the compatibility chart, and the lined products listed above are the matching real hardware, PFA-lined to DIN 7080 with borosilicate glass panes.

AVCO's 6100 Series names food & beverage and paper & pulp as served industries and meets TAPPI TIS 405-8, but publishes no 3-A or FDA certification — treat this family as utility, byproduct, or solids-duty service rather than product-contact. The compatibility chart adds a real caution for pulp-and-paper lines: white liquor at 80°C drops 316SS to "C," and sulfite liquor holds it only at "Good" — the Hastelloy body/shim option (alongside 304SS and 316SS) is not a luxury on hot pulping-liquor lines.

NEXT STEP

Send LibertyCES the process data, not a part number.

Ten valve architectures, real vendor compatibility data, one guide — but your actual application still has a specific chemical, concentration, temperature, and duty cycle that determines which body, seat, and seal material is correct. A spec review checks the exact conditions against the exact material, before equipment gets ordered.

Fluid, chemistry, concentration, temperature, flow, pressure, line size, and current equipment — that's what a real spec review needs to start.

Request a spec review

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