Butterfly Valve Types — Concentric, High-Performance, Triple-Offset

cBallast Technical Sourcing · Butterfly valve · issued 2026-07-14 · cballast.com/documents/butterfly-valve-types-concentric-high-performance-triple-offset

Butterfly valve type selection covering the three dominant geometries: concentric (resilient-seated), high-performance (double-offset, PTFE-seated), and triple-offset (metal-seated). Includes pressure/temperature service envelopes, seat/seal materials, actuation options, and API 609 category A/B classification.

The three geometries

Type | Stem offset | Seat | Pressure class | Temperature |

Concentric (resilient-seated) | None — stem passes through disc centreline | Elastomer (EPDM / NBR / FKM) | Up to PN 10 / PN 16 | -40 to +140 °C |

High-performance (HPBV, double-offset) | Two offsets (stem from centreline, disc from stem) | PTFE or reinforced polymer | Up to ANSI 300 / PN 40 | -46 to +230 °C |

Triple-offset (TOBV, metal-seated) | Three offsets (double-offset + cone angle) | Metal (17-4PH, Stellite, Inconel) | Up to ANSI 600 / PN 100 | -196 to +550 °C |

Concentric — the utility valve

The stem centreline passes through the disc centreline. When the disc closes, its rim scrubs across the elastomer seat around the entire body bore. Wafer and lug body styles fit between ANSI 125/150 or PN 10/16 flanges. Concentric valves are the workhorse of building services, HVAC water loops, marine cooling loops and industrial water treatment. They cost 20-30% of a comparable HPBV and are readily available.

Seat elastomers determine media compatibility and temperature: EPDM for hot and cold water, glycol, and steam < 130 °C; NBR (Buna-N) for hydrocarbons and oil-in-water; FKM (Viton) for higher-temperature hydrocarbons and aggressive process fluids.

High-performance (HPBV) — the process valve

The stem is offset from the disc centreline and the disc's sealing face is further offset from the stem. This double-offset geometry lifts the disc rim clear of the seat during the first few degrees of opening, so the seat sees no rubbing wear during actuation — dramatically extending seat life on frequent-cycling process service. A PTFE-lined seat handles up to ~230 °C and provides bubble-tight (ISO 5208 rate A) shutoff for hydrocarbons, most acids, and steam.

Triple-offset (TOBV) — the safety-critical valve

Adds a third offset: the seat cone axis is offset from the pipe centreline by 3-5°. The disc contacts the seat only in the very last few degrees of closure, so seat rub is eliminated. The metal-to-metal seat is bubble-tight to ISO 5208 rate A on gas at ANSI 600 / PN 100 pressure classes and temperatures from -196 °C (LNG) to +550 °C (superheated steam). TOBVs replace globe valves and API 6D ball valves in critical isolation service where fire-safe rating (API 607 / API 6FA) is required.

Actuation

Actuator | Use |

Manual lever (up to DN 200) | Small line-size, infrequent operation, isolation duty |

Manual gear (DN 200 and above) | Larger sizes where hand torque exceeds 100 Nm |

Pneumatic spring-return | Fail-safe process shutoff (fail-closed or fail-open on air loss) |

Pneumatic double-acting | High-cycle process modulation, air-motor speed |

Electric (24 V DC / 230 V AC) | Slow-cycling process, HVAC, remote isolation without air supply |

Electro-hydraulic | Large-torque process valves in ESD (emergency shutdown) service |

Sizing check

A butterfly valve is sized on flow coefficient Cv (imperial) or Kv (metric); Kv = 0.865 × Cv. The manufacturer's Cv-vs-opening curve is a stretched-S shape — most flow change occurs between 30° and 70° open, so a valve should always be sized to run in that window at design flow to give good control. Undersized valves saturate near 100% open; oversized valves throttle in the noisy last 10° range.

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