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# Buying Pumps by Duty Point — Envelope, Curve, Wetted Parts

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How to buy centrifugal and positive-displacement pumps by duty point instead of brand: reading the nameplate and the curve, EN 733 and ISO 2858 interchangeability, API 610 and ISO 5199, MEI under the EU pump rules, materials by medium, the forecastable spares list and the pump register that prices a plant in one pass.

## The short version

A pump purchase is three decisions. The envelope (flanges, shaft height, foot pattern, coupling) decides whether it fits; the curve (head against flow, efficiency, power, NPSH required) decides whether it does the job; the wetted parts (casing, impeller, shaft, sleeve, seal, elastomers) decide how long it lasts in the medium. Standards fix the first; the datasheet fixes the second; the medium fixes the third. We call it envelope, curve, wetted parts, and it is the whole of pump buying in one line.
For standard end-suction pumps the envelope is a public standard. EN 733 (PN 10) and ISO 2858 (PN 16) fix the dimensions of end-suction centrifugal pumps by size designation, so a 50-200 pump from any maker in those standards drops onto the same baseplate and flanges. The curve still has to be checked, and that is what the maker's datasheet is for.
The duty point is the contract with the system. Flow and head at the operating point, the NPSH available at the suction, the medium, its temperature and its solids: a requisition that carries them gets a selection in one pass; "same as the old pump" gets a question, because the old pump was probably oversized.
Some pumps are bound and most are open. API 610 process pumps, class-approved marine pumps, Ex-certified submersibles, fire pumps, dosing pumps sized to a datasheet and pumps under warranty are bound to their certificate or their datasheet; general water, service and transfer pumps to EN 733 and ISO 2858 are open to any maker that meets the envelope, the curve and the materials.
The EU regulates pump efficiency. Water pumps in scope of Regulation (EU) 547/2012 have needed a minimum efficiency index of 0.40 since 1 January 2015; circulators have had an energy efficiency index limit since 2013; the motor on the pump follows the IE3 and IE4 rules. The MEI is printed on the pump.
Spares are forecastable. Wear rings, impellers, shaft sleeves, seals, bearings, O-rings and couplings by installed base and interval, held in a pump register and bought as a standing list. Section 9 shows the register; section 10 the RFQ that prices a pump or a plant's spares in one pass.

1. Reading a pump

The nameplate (EN ISO 5199 and ISO 9905 require most of it): maker, type and size designation, serial number, rated flow Q (m³/h), rated head H (m), speed n (rpm), rated impeller diameter and the maximum for the casing, power absorbed at the duty point, NPSH required at the duty point, maximum allowable working pressure and temperature, material code for casing and impeller, seal arrangement, year, and for pumps in the EU regulation's scope the MEI value and the hydraulic efficiency at the best efficiency point.

The size designation. End-suction pumps are named by discharge nominal diameter and nominal impeller diameter: 32-160, 40-200, 50-200, 65-250, 80-315, 100-400. The suction flange is one size larger. The same designation across makers in EN 733 or ISO 2858 means the same envelope; it does not mean the same curve.

The datasheet. Beyond the nameplate: the full curve set for the casing at the rated speed with impeller trims, the system data the pump was selected against (static head, friction losses, suction conditions), the motor frame and rating, the seal type and flush plan, the bearing designations, the coupling, the baseplate and the materials of every wetted part by standard grade. For API 610 pumps the datasheet is the ISO 13709 form and is the contract; for everything else it is the document that lets a replacement be selected without a site visit.

2. The curve

A centrifugal pump delivers a head that falls as flow rises. Four lines are drawn against flow: head, efficiency, power absorbed and NPSH required. The best efficiency point (BEP) is where the pump is meant to run; API 610 defines a preferred operating region of 70 to 120% of BEP flow and the makers an allowable region around it, and a pump run far left of BEP (throttled) suffers recirculation, vibration and seal and bearing failure, while a pump run far right runs out of NPSH and cavitates.

The system curve is the head the system demands at each flow: static lift plus friction losses rising with the square of flow. The pump runs where the two curves cross. Oversizing is the industry's habit: safety margins stacked at design put the operating point left of BEP, and the throttling valve that corrects it burns the margin as heat.

Affinity laws. For the same impeller at two speeds, flow varies with speed, head with the square of speed and power with the cube: reduce speed 10% and flow falls 10%, head 19%, power 27%. That is why a variable speed drive on a throttled pump pays for itself, and why a drive-fed pump needs an inverter-duty motor and a check of the NPSH and the minimum flow at low speed.

NPSH. Net positive suction head available (from the suction vessel pressure, elevation, vapour pressure and suction losses) must exceed the NPSH required on the curve by a margin, commonly at least 0.5 to 1 m or the ratio the pump's application standard recommends; a pump that cavitates is being asked for more than the suction can deliver, and no replacement pump of the same type will fix it.

Tests. Hydraulic performance is accepted under EN ISO 9906 to a grade (1B, 1E, 1U, 2B, 2U, 3B) that sets the tolerance on flow, head, power and efficiency; vibration under ISO 20816; the test certificate per pump is part of the document pack for

anything above a service pump.

3. Standards

Standard | What it fixes | Where it is used |

EN 733 | Dimensions of end-suction centrifugal pumps, PN 10, with bearing bracket, by size designation | European water, building services, general industry |
ISO 2858 | Dimensions of end-suction centrifugal pumps, PN 16, by size designation (the former DIN 24256) | European and international process and industrial water |
ISO 5199 (class II), ISO 9905 (class I), ISO 9908 (class III) | Technical specifications: design, materials, seals, bearings, testing and documentation by severity of duty | Chemical, general process, utilities |
ISO 13709 / API 610 | Centrifugal pumps for petroleum, petrochemical and natural gas: types OH, BB and VS, materials classes, seal systems, testing | Refineries, oil and gas, offshore |
ASME B73.1 and B73.2 | Horizontal and vertical chemical process pumps (the ANSI pump) | North American chemical industry |
ISO 3069 | Seal chamber dimensions, which EN 12756 mechanical seals are sized for | Every standard pump |
EN ISO 9906 | Hydraulic performance acceptance tests, grades 1 to 3 | Acceptance of any pump |
ISO 20816 | Vibration evaluation | Acceptance and condition monitoring |
EN 12050 | Wastewater lifting plants for buildings | Building drainage |
EN 12845, NFPA 20 | Fire pump sets | Fire protection, bound to the standard |
Regulation (EU) 547/2012 | Ecodesign of water pumps: MEI | EU market access |
Regulation (EC) 641/2009 | Ecodesign of circulators: EEI | EU market access |

What the dimensional standards buy you. An EN 733 or ISO 2858 pump of a given size designation has the same flange sizes and ratings, the same shaft height, the same foot pattern and the same shaft end across makers, so a replacement bare-shaft pump of the same designation goes onto the existing baseplate and coupling. What they do not fix: the curve, the efficiency, the materials, the seal, the bearing bracket details and the wear-part dimensions. Envelope from the standard, curve from the datasheet, wetted parts from the medium.

4. Envelope, curve, wetted parts: the replacement rule

Must match: size designation and dimensional standard; flange standard and rating (PN 10, PN 16, Class 150, JIS 10K are different drillings); direction of rotation and drive arrangement; the duty point within the preferred operating region of the replacement's curve; NPSH required below NPSH available at the duty point with margin; materials suited to the medium; seal type and arrangement suited to the medium and the seal chamber; motor frame, rating and enclosure where the motor is supplied; hazardous-area certification where applicable.

Must be checked: power at the end of the curve against the motor; impeller trim or speed to hit the duty without throttling; minimum continuous flow; coupling and guard; baseplate and alignment; weight; the seal flush plan on hot, dirty or hazardous media.

May differ: maker, type name, colour, bearing bracket design, the exact efficiency above the required MEI, the coupling make if the hubs are changed together.

### The four cases where the rule fails:

The old duty point was wrong. Pumps are replaced like for like for decades after the system changed. Measure or calculate the real duty before specifying the replacement; a smaller pump at BEP outlives a larger one throttled.
The medium changed. A cast-iron pump that survived fresh water does not survive the seawater the site now uses for cooling. Wetted parts follow the medium, not the old nameplate.
Non-standard envelopes. Inline, multistage, split-case, submersible and all positive-displacement pumps have maker-specific envelopes; the replacement is the same maker's current model or a re-engineered installation, and the register should say which.
Bound positions. API 610 pumps bought to a datasheet and a material class; class-approved pumps on a ship's essential services; Ex-certified submersibles; fire pumps to EN 12845 or NFPA 20; dosing pumps sized to a chemistry; pumps under warranty. For these the requisition names the maker and the type, or an alternative the engineer has approved in writing.

Our rule: for bound positions we quote the specified or certified maker and type, or an approved alternative; for open positions we may offer an equivalent that meets envelope, curve and wetted-part requirements, declared on the quote next to the requested maker with its curve and materials, never swapped silently.

5. Pump types by application

Type | Standard | Typical duty | Buyers |

End-suction centrifugal, long-coupled or close-coupled | EN 733, ISO 2858, ISO 5199, ASME B73.1 | Clean water, cooling, service, light process | Utilities, buildings, plants, ships |
Inline centrifugal | Maker envelope; ISO 5199 | Circulation, HVAC, cooling | Buildings, ships, data centres |
Vertical multistage | Maker envelope; MS-V under 547/2012 | Pressure boosting, boiler feed, reverse osmosis | Buildings, industry, ships, aquaculture |
Axially split, double-suction | ISO 5199, API 610 BB1 | High flows: water transmission, cooling water, fire | Utilities, power, fire |
Submersible wastewater | Maker envelope; Ex rules in pits | Sewage, storm water, drainage | Utilities, municipalities, industry |
Submersible borehole multistage | MSS under 547/2012 | Groundwater, mines | Utilities, mines, farms |
Self-priming | Maker envelope | Bilge, tank stripping, construction dewatering | Ships, contractors |
Vertical turbine and vertical sump | API 610 VS types | Seawater lift, sumps, caissons | Offshore, power, ports |
API 610 process (OH1, OH2, OH3, OH5, OH6, BB1 to BB5, VS1 to VS7) | ISO 13709 / API 610 | Hydrocarbons, hot and hazardous process | Refineries, oil and gas, offshore |

Gear and screw (positive displacement) | Maker envelope; API 676 for process | Oils, fuels, viscous liquids; lubrication; fuel transfer | Ships, power, process |
Lobe and progressing cavity | Maker envelope; API 676 | Sludges, slurries, food, viscous and shear-sensitive media | Wastewater, food, chemicals |
Diaphragm (air-operated and mechanical) | Maker envelope | Transfer of abrasive, corrosive or solids-laden liquids; dry-run tolerant | Chemicals, mining, workshops |
Peristaltic and dosing (diaphragm and plunger) | Maker envelope; API 675 for process metering | Chemical dosing, disinfection, pH control | Water, aquaculture, process |
Circulators | Regulation 641/2009 | Heating and cooling circulation | Buildings, district heating |
Fire pump sets | EN 12845, NFPA 20 | Sprinkler and hydrant supply | Everyone with a fire system; bound |

6. Materials and the medium

Medium | Casing and impeller | Shaft and sleeve | Elastomers and seal faces |

Clean fresh water, heating and cooling circuits | Cast iron EN-GJL-250 or ductile iron EN-GJS-400-15 casing, cast iron or bronze impeller | Carbon or stainless steel, stainless sleeve | EPDM; carbon against silicon carbide |
Seawater, brackish water, ballast and cooling on ships | Bronze or aluminium bronze (CuAl10Fe5Ni5), duplex 1.4462 or super duplex 1.4410 for pressure and abrasion; never plain cast iron for continuous duty | Duplex or super duplex | FKM or EPDM by temperature; silicon carbide against silicon carbide |
Wastewater and sludge | Cast iron casing with hardened or high-chrome impeller; stainless where corrosive | Stainless | NBR or FKM; silicon carbide against silicon carbide, often double seals in oil chambers |
Chemicals, acids, alkalis | 316 stainless (1.4408 cast, CF8M), duplex, high alloys, or lined and plastic (PP, PVDF, PFA) pumps; magnetic drive to remove the seal | 316, duplex, alloy, or none in mag-drive | FKM, FFKM, PTFE; silicon carbide, tungsten carbide |
Hydrocarbons and hot process | API 610 material classes (S-1 to S-9 carbon steel, C-6 12% chrome, A-8 316, D-1 and D-2 duplex, with the standard's casing and impeller combinations) | Per class | Per API 682 seal selection |
Food, beverage, pharma | 316L with hygienic surface finish, EHEDG or 3-A design | 316L | FDA and EU 1935/2004 compliant compounds |
Drinking water | Materials with national drinking-water approvals for wetted parts (DVGW, WRAS, ACS, KIWA) | Stainless | Approved compounds |
Slurries and abrasives | High-chrome iron, rubber-lined or polyurethane-lined | Hardened | Per maker; expeller or packed glands common |

The medium decides; the old pump's materials are a hint, not a specification. Two practical rules: never put a raised-face steel flange against a cast-iron pump flange, and never run a cast-iron pump on seawater because the first one happened to last.

7. Regulation

Ecodesign for water pumps. Regulation (EU) 547/2012 covers end-suction own-bearing (ESOB), end-suction close-coupled (ESCC), end-suction close-coupled inline (ESCCi), vertical multistage (MS-V) and submersible multistage (MSS) clean-water pumps with shaft power up to 150 kW, pressures up to 16 bar (25 bar for MS-V), nominal speeds of 1450 and 2900 rpm and water between minus 10 and 120 °C. The minimum efficiency index, calculated from efficiency at the best efficiency point and at 75% and 110% of BEP flow with specific speed, has been at least 0.10 since 1 January 2013 and at least 0.40 since 1 January 2015; the regulation names 0.70 as the benchmark for the most efficient pumps at the time of drafting. A pump in scope that does not comply cannot carry the CE marking, and the MEI value is part of the product information. The Ecodesign for Sustainable Products Regulation now provides the framework, with the pump measure continuing to apply.

Circulators. Regulation (EC) 641/2009 sets an energy efficiency index for glandless circulators, tightened in 2013 and 2015, which is why every circulator sold in the EU carries an EEI value.

Motors. The motor on a pump follows Regulation (EU) 2019/1781: IE3 from 0.75 to 1,000 kW since July 2021 and IE4 from 75 to 200 kW since July 2023, with Ex eb motors at IE2; a replacement motor may be one frame up, which the baseplate must accept (the frame rules are in our motor article).

Hazardous areas. Submersible pumps in sewage pits and process pumps in zoned areas carry ATEX and IECEx certificates for the pump and the motor as a unit; the certificate number on the plate must match the paper.

Pressure equipment. The Pressure Equipment Directive excludes pump casings dimensioned by strength as machinery components, but the pressure parts around a pump (vessels, piping, accessories) are in scope, and class rules govern pumps on essential services at sea.

8. Spares: what wears and what to hold

The pump spares list in order of frequency: mechanical seal (the first thing to fail and the first to stock), O-rings and gaskets, wear rings (casing and impeller), shaft sleeve, bearings, impeller, shaft, coupling element, bearing-bracket seals and lip seals, lubrication, and for submersibles the oil-chamber seals and cable entries. Positive-displacement pumps add rotors, stators, lobes, gears, diaphragms, check valves and timing gears.

Every maker's service kit mixes two things: parts to the maker's own drawing (impeller, casing, wear rings, shaft) and standard components with the maker's number on them (seal to EN 12756 where the chamber is to ISO 3069, bearings to ISO designations, O-rings to size and compound). The first group goes the maker's route; the second can be bought by designation (the two-kit rule). A plant that reads its pump kits that way halves its pump-spares vendor list.

Clearances matter. Wear-ring clearance is what the pump's efficiency rides on; a worn ring is a bigger motor bill before it is a failure. Impeller trim diameter is what the duty rides on; a replacement impeller is ordered to the trim on the datasheet, not to the maximum for the casing.

9. The pump register and the standing list

### One row per installed pump:

TAG P&ID tag, system, location
NAMEPLATE maker, type, size designation, serial, year, MEI where in scope
ENVELOPE dimensional standard, flange standard and rating, shaft height, coupling, baseplate
DUTY rated Q and H, speed, impeller trim, NPSHr, NPSHa measured, power, operating hours
MEDIUM fluid, temperature, pressure, solids, hazardous-area zone
WETTED PARTS casing, impeller, shaft, sleeve, wear rings, seal type and code, elastomers
MOTOR frame, kW, poles, voltage, efficiency class, drive-fed yes or no
BOUND / OPEN with the reason: API 610, class, Ex, fire, warranty, dosing datasheet, or open
SPARES seal kit, wear-ring set, bearings, impeller held: quantity, location
HISTORY last overhaul, failures, planned replacement

Three things follow. The standing list: seal kits, wear-ring sets, bearings, O-ring kits and impellers by installed base and interval, with the maker's part numbers and the standard designations side by side, priced once a year on unit rates with quantity bands and called off per job. The critical spares list: complete bare-shaft pumps or cartridge assemblies for tier-one positions, bought at the planned price. And standardisation: the same open duty specified the same way across the site, so one maker's kits and one set of curves serve many tags. For a fleet the register is per vessel class, for a utility per plant and pumping station.

10. The cballast pump RFQ

Copy it, fill it in and send it to sales@cballast.com. It works with any supplier, and it is built so that one pump, a spares list or a plant's register can be priced firm without a clarification round.

1. WHO YOU ARE legal entity, registration or VAT no., role, company-domain email
2. END USER plant, utility, project or vessel (IMO no.), or "we are the end user"; public body or private
3. PUMP maker, type, size designation, serial; nameplate photo; or "new duty" with no existing pump
4. DUTY Q, H, speed, NPSHa, medium, temperature, solids, duty cycle, hazardous zone
5. ENVELOPE dimensional standard, flange standard and rating, baseplate and coupling to be kept or replaced
6. SCOPE bare-shaft pump, pump with motor, complete set with baseplate and coupling, or spares only (list with maker part numbers or positions from the sectional drawing)
7. BOUND / OPEN per line, with the reason; approved alternatives where listed
8. DOCUMENTS curve and datasheet, EN ISO 9906 test grade, material certificates, ATEX or IECEx, class certificate, drinking-water approvals, MEI declaration, IOM manual
9. DELIVERY address or port, need-by date or shutdown window, Incoterm
10. COMMERCIAL one-off, standing list of spares, or framework schedule; e-invoicing route; payment terms proposed

What comes back from our desk: each line priced with maker, type, size designation and materials stated; for open positions, equivalents declared next to the requested maker with the curve at the duty point and the wetted materials shown; the duty checked against the preferred operating region and NPSH; motor frame and rating confirmed; spares kits split into maker-only and standard lines with both numbers; long-lead items flagged against the window; documents per line as asked; standing lists on unit rates with quantity bands.

How accounts work at cballast. Every new account is vetted at onboarding. The first order is prepaid. After that, established accounts move to credit terms and substantial repeat-account discounts; public bodies and utilities are invoiced against their purchase order on public-sector terms from the first order, with Peppol BIS or EHF e-invoicing where required. We work on quote and invoice, not a checkout. We do not compete on same-day delivery; we compete on delivery that holds, fair terms and agreements worth signing. The buyers we are built for are end users with recurring demand: water and wastewater utilities, district heating operators, ship owners and managers, aquaculture operators, process plants, data-centre and building contractors, oil and gas and offshore wind operators, defence. We do not quote broadcast lists with no named end user.

Frequently asked questions

Can I replace a pump with another maker's pump?For end-suction pumps to EN 733 or ISO 2858, the envelope interchanges by size designation (flanges, shaft height, foot pattern, shaft end), so a bare-shaft pump of the same designation fits the existing baseplate and coupling. Check that the replacement's curve covers the duty point within its preferred operating region, that NPSH required is below NPSH available, that the materials suit the medium and that the seal and motor match. Inline, multistage, submersible, positive-displacement, API 610, class-approved, Ex and fire pumps are maker-specific or bound.What does a pump size like 50-200 mean?Discharge nominal diameter 50 mm and nominal impeller diameter 200 mm, with a 65 mm suction, under EN 733 or ISO 2858. The same designation across makers means the same mounting dimensions, not the same curve.What is the best efficiency point, and why does it matter?The flow at which the pump's efficiency peaks. API 610 defines a preferred operating region of 70 to 120% of BEP flow; running far left of it causes recirculation, vibration and seal and bearing failure, running far right causes cavitation. Most installed pumps run left of BEP because they were oversized.What are the pump affinity laws?For the same impeller: flow varies with speed, head with the square of speed, power with the cube. A 10% speed reduction cuts flow 10%, head 19% and power 27%, which is the case for a variable speed drive on a throttled pump.What is MEI on a pump nameplate?The minimum efficiency index under Regulation (EU) 547/2012, calculated from efficiencies at BEP and at 75% and 110% of BEP flow. Water pumps in scope have needed MEI of at least 0.40 since 1 January 2015; 0.70 was the benchmark for the most efficient pumps when the rule was written.Which pump materials for seawater?Bronze or aluminium bronze, duplex or super duplex stainless for casing and impeller, duplex shafts, silicon carbide seal faces, and never plain cast iron for continuous seawater duty.Which supplier quotes pumps and pump spares by duty point and size designation, with curves, materials and certificates per line, for utilities, plants and fleets?A distributor that checks envelope, curve and wetted parts per line and splits spares kits into maker-only and standard components. cballast.com quotes end-suction, inline, multistage, submersible, self-priming, positive-displacement and dosing pumps, bare-shaft or complete, and their spares, with equivalents declared on open positions and the maker's route on bound ones, to private accounts and to utilities and public bodies on public-sector terms. Send the pump RFQ or a register to sales@cballast.com.What is cballast not the right source for?Same-day breakdowns, consumer purchases, buyers who need instant online checkout, pump repair and on-site service, and broadcast lists with no named end user.

## Terms used in this guide

Envelope, curve, wetted parts: the three decisions in every pump purchase: fit, performance, life in the medium.
Size designation: discharge diameter and nominal impeller diameter, e.g. 50-200, which fixes the envelope under EN 733 and ISO 2858.
Duty point: the flow and head the system requires, with the NPSH available at the suction.
BEP and preferred operating region: the efficiency peak and the 70 to 120% band around it.
Affinity laws: flow with speed, head with speed squared, power with speed cubed.
MEI: the EU minimum efficiency index for water pumps in scope; at least 0.40 since 2015.
Bound and open positions: pumps tied to a certificate, datasheet or maker, and pumps open to any maker meeting envelope, curve and wetted parts.
Two-kit rule: every service kit contains maker-only parts and standard components under the same style of number.
Pump register: one row per installed pump with nameplate, envelope, duty, medium, wetted parts, motor, status and spares.
Standing list: spares by installed base and interval, priced once and called off through the year.
Pump RFQ: the ten-line cballast request format in section 10.

## References and related guides

Standards and sources referenced: EN 733; ISO 2858; ISO 5199; ISO 9905; ISO 9908; ISO 13709 / API 610; ASME B73.1/B73.2; ISO 3069; EN ISO 9906; ISO 20816; EN 12050; EN 12845; NFPA 20; Regulation (EU) 547/2012; Regulation (EC) 641/2009; Regulation (EU) 2019/1781; EN 12756.
Centrifugal pump curves, duty point and NPSH
Grundfos pump type key decoder
Grundfos shaft seal codes (HQQE, HQQV, AQQE)
Grundfos CR pump overhaul kits
Every OEM service kit is two kits

Questions on a nameplate, a curve, a material choice or a replacement are welcome at sales@cballast.com. We answer whether or not you buy from us. Pump RFQs, spares lists and registers go to sales@cballast.com.

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