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# NEMA vs IEC Motor Frames — Cross-Reference Chart

cBallast Technical Sourcing · Low-voltage electric motors · issued 2026-11-09 · cballast.com/documents/nema-vs-iec-motor-frames-cross-reference

Replacing across the Atlantic divide: the frame cross-reference table pairing IEC 80 to 225 frames with NEMA 56 to 365T at equal powers and speeds, what actually differs — shaft diameters and keys in millimetres against inches, foot hole patterns, flange systems (B5/B14 against C-face/D-flange), service factor against duty type, insulation and efficiency labels (IE3/IE4 against NEMA Premium), 50/60 Hz speed and power shifts — and the honest adapter-and-machining paths when a like-for-like swap does not exist.

## The short version

IEC and NEMA both standardise motor mechanics by frame numbers, but the numbers encode different things: IEC frames (63, 71, 80, 90, 100, 112, 132, 160, 180, 200, 225…) state the shaft-centre height in millimetres; NEMA frames (48, 56, 143T, 145T, 182T…) encode the centre height in quarter-inches (digits/4 for the first two digits) plus mounting dimensions in the suffix. A 132 frame is 132 mm to shaft centre; a 213T is 21/4" + letters.
At equal power and speed the usual pairs are: IEC 80 ↔ NEMA 56; IEC 90 ↔ 143T/145T; IEC 100 ↔ 182T; IEC 112 ↔ 184T; IEC 132 ↔ 213T/215T; IEC 160 ↔ 254T/256T; IEC 180 ↔ 284T/286T; IEC 200 ↔ 324T/326T; IEC 225 ↔ 364T/365T — pairs of comparable envelope, not bolt-in twins: feet, shafts and flanges still differ in actual millimetres and inches.
The electrical divide travels with the mechanical one: 50 Hz IEC nameplates (230/400, 400/690 V) against 60 Hz NEMA (230/460, 460 V); NEMA's service factor (1.15 SF class headroom) has no IEC twin — IEC motors state duty types (S1–S10) instead; efficiency labels map IE3 ≈ NEMA Premium as a buying class (IE classes here).
A 50 Hz motor on 60 Hz runs ~20% faster and (set up correctly on V/Hz) delivers correspondingly more power through the fan and pump laws — but bearings, fans and driven machines must tolerate the speed; the clean modern answer for cross-frequency fleets is a VFD doing the translation (cabling per our VFD cable guide).
Replacement paths in order of preference: (1) same-system replacement (IEC for IEC — e.g. a WEG W22 IE3 3 kW B3 or an ABB M3BP 132M marine motor); (2) cross-system with adapter base/flange and coupling rebore — routine machine-shop work when planned; (3) re-engineering the drive end only when (1) and (2) genuinely fail. The IEC frame dimension chart carries the millimetre side of every such job.

1. The cross-reference table (4-pole class, equal duty)

Typical power (kW / hp) | IEC frame | NEMA frame | IEC shaft (mm) | NEMA shaft (in) |

0.75 / 1 | 80 | 56 / 143T | 19 | 5/8 / 7/8 |

1.1–1.5 / 1.5–2 | 90S/90L | 143T/145T | 24 | 7/8 |

2.2–3 / 3 | 100L | 182T | 28 | 1 1/8 |

4 / 5 | 112M | 184T | 28 | 1 1/8 |

5.5–7.5 / 7.5–10 | 132S/132M | 213T/215T | 38 | 1 3/8 |

11–15 / 15–20 | 160M/160L | 254T/256T | 42 | 1 5/8 |

18.5–22 / 25–30 | 180M/180L | 284T/286T | 48 | 1 7/8 |

30–37 / 40–50 | 200L | 324T/326T | 55 | 2 1/8 |

45–55 / 60–75 | 225S/225M | 364T/365T | 60* | 2 3/8 |

Orientation table, with the caveats that make it honest: pairings shift one step at 2-pole speeds and at the edges of each frame's power band (makers stretch frames differently); the asterisked 225 shaft is 55 mm on 2-pole variants; and the pairing never promises bolt-in interchange — it tells you which machines are candidates, after which the foot and shaft tables decide the adapter work. For the IEC dimensions themselves (foot holes A/B, shaft E lengths, flange spigots) use the IEC frame size chart; for replacement-contract thinking on worn fleets, the frame contract guide.

2. What actually differs — the five gaps to bridge

Gap | IEC side | NEMA side | Bridge |

Shaft & key | Metric diameters, DIN 6885 keys | Inch diameters, inch keys | Rebore/rekey the coupling or pulley — standard shop work; never shim an inch bore onto a metric shaft |

Feet | Metric hole pattern per IEC 60072 | Inch pattern per NEMA MG-1 | Adapter base plate (drilled both patterns) — the standard cross-system fix |

Flanges | B5 (bolt-through) / B14 (tapped) spigot flanges | C-face (tapped) / D-flange (bolt-through) | Adapter flanges exist for common pump interfaces; check spigot diameters, not just bolt circles |

Electrical nameplate | 50 Hz, 230/400 or 400/690 V, duty S1–S10 | 60 Hz, 230/460 V, service factor 1.15 class | Match the network; across frequency use a VFD or verify the maker's 50/60 dual rating line |

Labels & compliance | IE efficiency classes, CE/EcoDesign minimums | NEMA Premium, DOE minimums | Buy to the destination market's legal minimum — IE3 and NEMA Premium are the matching commercial classes |

3. Frequency, speed and the marine 60 Hz world

Ships largely run 60 Hz networks (440/690 V classes), which is why "NEMA motor" questions on board are usually really 60 Hz questions: an IEC-frame motor wound for 60 Hz is an ordinary catalogue article (the marine-spec M3BP class exists precisely for this), and most modern IEC machines carry dual 50/60 Hz nameplate lines. The physics for mixed cases: speed scales with frequency (a 1,450 rpm 50 Hz machine runs ~1,750 rpm at 60 Hz), centrifugal loads rise with the square and absorbed power with the cube of speed on fans and centrifugal pumps — so a frequency move without a drive wants the driven machine checked before the motor. Across the board, the clean modern bridge is the VFD: it decouples network frequency from shaft speed, serves both 50 and 60 Hz fleets with one spares line, and brings its own rules on cabling and EMC and on duty-type selection. Efficiency compliance follows the market the motor enters — EcoDesign IE3/IE4 floors in Europe, DOE/NEMA Premium in North America — and mixed fleets simply buy the higher class and stop thinking about it, which is also where the IE class guide lands.

4. The replacement method that avoids re-engineering

Work the nameplate first: power, speed/poles, frequency and voltage, frame, mounting (B3 foot / B5 / B14 / B35 against C-face/D-flange), shaft dimensions, duty or SF, efficiency class — then decide the path. Like-for-like within the system when the network matches (IEC 132S B3 dies → IEC 132S B3 arrives; our range covers the WEG W22 programme from 3 kW through 11 kW to 22 kW 2-pole IE3). Cross-system swap when the dead motor is the odd one out: pick the paired frame from the table, order the adapter base and coupling rebore with the motor, and the fitter's day stays a day. Fleet rationalisation when a plant or vessel carries both worlds: standardise on the dominant system, hold conversion hardware for the stragglers, and let attrition clean up the roster — the replacement-contract approach prices this as one programme. Bearings, fans and starters/protection ride every such order; a motor RFQ that names the driven machine gets all of it right in one pass.

How buying works at cballast. We quote IEC- and NEMA-frame machines, 50 and 60 Hz windings, marine variants and the adapter hardware between the systems — with the cross-reference basis stated per line. Accounts are vetted at onboarding; first order prepaid; established accounts on credit terms with repeat discounts; public bodies and utilities invoiced against purchase order from the first order. RFQs to sales@cballast.com.

## Frequently asked questions

What is the IEC equivalent of a NEMA 143T frame?The IEC 90 frame occupies the same power/speed territory (1.1–1.5 kW class at 4-pole). Equivalent means comparable envelope, not identical holes: the 143T shaft is 7/8" with an inch key, the IEC 90 shaft 24 mm metric — plan a coupling rebore or adapter when crossing.
How do NEMA frame numbers encode dimensions?The first two digits are the shaft-centre height in quarter-inches (14xT → 14/4 = 3.5"), remaining digits and letters set foot spacing and the T-series mounting generation. IEC frames state centre height directly in millimetres (132 = 132 mm). Both systems then publish full foot/shaft/flange tables per frame.
Can I run a 50 Hz motor on 60 Hz?Often, with care: at 60 Hz it runs ~20% faster; on V/Hz-proportional supplies many machines carry a dual nameplate line rating them for it. The driven machine is the real question — fans and centrifugal pumps absorb power with the cube of speed. The clean answer for mixed fleets is a VFD.
What is service factor and does IEC have it?NEMA's service factor (commonly 1.15) is sanctioned continuous overload headroom at rated conditions. IEC does not use SF — it defines duty types S1–S10 instead and expects selection at the real duty. When translating, treat an SF 1.15 NEMA machine as an S1 machine with margin, and size the IEC replacement honestly for the load.
Is IE3 the same as NEMA Premium?As a commercial efficiency class, effectively yes — they are the matching tiers each side of the Atlantic, with IE4 the step above. Legal minimums differ by market and power band; buying IE3/NEMA Premium or better satisfies both worlds in the common industrial range.
What is the difference between a B5 flange and a C-face?Both are drive-end mounting flanges, but B5 (IEC) is a large bolt-through flange and B14 its tapped-hole sibling, while NEMA's C-face is tapped and the D-flange bolt-through — with different spigot and bolt-circle dimensions throughout. Pump adapters between the systems exist for common sizes; verify spigot fit, not just bolt pattern.
Who supplies IEC and NEMA frame motors in Europe?cballast.com quotes IEC machines (WEG, ABB classes including marine variants), 60 Hz windings, and cross-system replacements with adapter hardware and rebores specified per line. Send the nameplate photo to sales@cballast.com.

## References and related guides

Standards and sources referenced: IEC 60072 / 60034 series (frames, duty types, efficiency classes); NEMA MG-1 (frames, service factor, Premium efficiency); EU EcoDesign and US DOE efficiency regimes; manufacturers' frame tables for the pairing practice.

## IEC motor frame size chart

## IEC motor efficiency classes IE1–IE5

## IEC motor duty classes S1–S10

## IEC motor replacement — the frame contract

## VFD motor cables — EMC, screening, length

## Motor starter finder

Questions on a cross-frame replacement or a 50/60 Hz case: write to sales@cballast.com. We answer whether or not you buy from us.

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