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The Frame Is the Contract — Replacing IEC Motors by Frame

cBallast Technical Sourcing · Low-voltage IEC electric motors · issued 2026-11-04 · cballast.com/documents/iec-motor-replacement-frame-contract

Any IEC motor of the same frame, mounting and poles bolts onto the old feet whoever made it — and the four cases where that fails. The frame dimension table, the EU IE3 and IE4 rules and the one-frame-up trap, marine, Ex and inverter specifications, and the 9-line spec that prices a whole site at once.

The short version

An IEC frame size is a dimensional contract. IEC 60072-1 fixes the shaft height, the shaft diameter and length, the foot-hole pattern and the flange for each frame. A 160M motor from any maker lands on the same four bolts and the same coupling as any other 160M. We call that like-for-fit: the frame, the mounting and the pole count decide fit; the maker does not.
Like-for-fit is where the saving is. Motors are the most standardised machine in a plant, so they are the easiest to compete, pool and stock by frame size instead of by maker type code.
The contract breaks in four places. A higher efficiency class can push the same power one frame up. Two-pole motors from frame 225 upward carry a smaller shaft than their four-pole twins. A 50 Hz motor on a 60 Hz supply runs 20% faster and can overload a pump or fan. NEMA and IEC frames are not interchangeable.
The EU rule changed what you can buy. Since July 2021, three-phase motors from 0.75 to 1,000 kW placed on the EU market must be IE3; since July 2023, 75 to 200 kW must be IE4, and Ex eb and single-phase motors must be IE2. A failed IE1 or IE2 motor in scope is replaced by an IE3 or IE4, which is why the one-frame-up check belongs on every replacement.
Ships and offshore units buy to a different ambient. 45 °C in machinery spaces, IP56 on deck, class F insulation with class B rise, heaters, marine paint, and class survey at test for essential-service machines of 100 kW and above.
Buy from a motor register, not from a failure. Frame, mounting, poles, power, voltage, enclosure and location per motor, with a standing list of frame sizes to hold as spares. Section 9 gives the 9-line spec that turns the register into a firm quote.

1. What a frame size fixes, and what it does not

IEC 60072-1 names a frame by its shaft height in millimetres (63, 71, 80, 90, 100, 112, 132, 160, 180, 200, 225, 250, 280, 315, 355, 400), followed by a letter for the foot-hole spacing along the shaft: S short, M medium, L long. The frame fixes:

H, shaft centre height above the feet.
D and E, shaft diameter and the usable shaft length.
A and B, foot-hole spacing across and along the shaft, and C, the distance from the shaft shoulder to the first foot hole.
The flange, by FF number for B5 (through holes) and FT number for B14 (tapped holes).

Frame | H (mm) | A x B (mm) | Shaft D (mm), 4-pole and above | Shaft D, 2-pole | B5 flange |

80 | 80 | 125 x 100 | 19 | 19 | FF165 |
90S / 90L | 90 | 140 x 100 / 140 x 125 | 24 | 24 | FF165 |
100L | 100 | 160 x 140 | 28 | 28 | FF215 |
112M | 112 | 190 x 140 | 28 | 28 | FF215 |
132S / 132M | 132 | 216 x 140 / 216 x 178 | 38 | 38 | FF265 |
160M / 160L | 160 | 254 x 210 / 254 x 254 | 42 | 42 | FF300 |
180M / 180L | 180 | 279 x 241 / 279 x 279 | 48 | 48 | FF300 |
200L | 200 | 318 x 305 | 55 | 55 | FF350 |
225S / 225M | 225 | 356 x 286 / 356 x 311 | 60 | 55 | FF400 |
250M | 250 | 406 x 349 | 65 | 60 | FF500 |
280S / 280M | 280 | 457 x 368 / 457 x 419 | 75 | 65 | FF500 |
315S / 315M / 315L | 315 | 508 x 406 / 508 x 457 / 508 x 508 | 80 | 65 | FF500 |
355M / 355L | 355 | 610 x 560 / 610 x 630 | 100 | 75 | FF600 |

What the frame does not fix: overall length and the fan-cover overhang, terminal-box position and size, weight, cooling method, bearing sizes, efficiency, noise, and whether the feet are cast with the housing or bolted on. All of those are checked, none of them stops a like-for-fit replacement by itself.

The usual four-pole assignment of power to frame, by convention and by EN 50347: 0.75 kW on 80; 1.1 on 90S; 1.5 on 90L; 2.2 and 3 on 100L; 4 on 112M; 5.5 on 132S; 7.5 on 132M; 11 on 160M; 15 on 160L; 18.5 on 180M; 22 on 180L; 30 on 200L; 37 on 225S; 45 on 225M; 55 on 250M; 75 on 280S; 90 on 280M; 110 on 315S; 132 on 315M; 160 and 200 on 315L. Section 3 says when this table lies.

2. Reading the nameplate for a replacement

IEC 60034-1 says what a nameplate must carry. For a replacement, read it in this order:

Frame designation with its letter, and the mounting code to IEC 60034-7: IM B3 foot, IM B5 flange, IM B14 face, IM B35 foot and flange, IM V1 flange shaft-down.
Rated output in kW, rated speed and pole count. 2-pole runs near 3,000 rpm at 50 Hz, 4-pole near 1,500, 6-pole near 1,000, 8-pole near 750. Speed decides the driven machine's duty, so poles must match.
Voltage, connection and frequency. 230 9B ò C Y for small motors, 400 9B ò c“ Y from a few kW up, or 440 V 60 Hz on most ships. The nameplate often carries both 50 Hz and 60 Hz ratings.
Rated current, power factor and efficiency class with efficiency at full, three-quarter and half load, which the EU regulation requires on the plate.

Duty type. S1 continuous for pumps and fans; S3 or S4 intermittent on cranes and winches, where the thermal rating differs.
Insulation class and temperature rise, usually F with B rise, which is the reserve that lets the motor run at 45 °C ambient or on an inverter.
IP code to IEC 60034-5 and cooling to IEC 60034-6. IP55 and IC411 (fan-cooled, finned housing) are the industrial standard; IP56 on weather decks; IP23 open motors in clean rooms.
Bearing designations, drive end and non-drive end, the standard catalogue bearings inside, with the lubrication interval.
Weight, ambient and altitude if other than 40 °C and 1,000 m.

3. Like-for-fit: the replacement rule

Must match: frame size with its S, M or L letter; mounting code; pole count; rated output at the site's frequency and voltage; frequency; enclosure IP; efficiency class at least as high as the regulation requires; duty type.

Must be checked: overall length and fan-cover overhang against the space; terminal-box position against the cable route; shaft diameter if the motor is a 2-pole in frame 225 or larger; weight against the base and the lifting gear; bearing arrangement if the drive is a belt (an axial-locating bearing and a strong drive-end bearing); inverter duty if a drive feeds it (section 7); ambient and Ex requirements (section 6).

May differ: maker, type code, colour, the exact efficiency figure above the required class, the fan material, the terminal-box make.

The four cases where like-for-fit fails:

One frame up. An IE3 or IE4 motor needs more active material than the IE1 it replaces. Many makers keep the EN 50347 frame; some move a given power one frame up, especially at 2-pole and at the top of a frame. The feet then move. Ask for the frame size, not just the power, and measure the old base before the order.
Two-pole shafts. From frame 225 upward, a 2-pole motor carries a smaller shaft than the 4-pole in the same frame (55 against 60 at 225, 65 against 75 at 280, 65 against 80 at 315). A coupling half bored for one does not fit the other.
50 Hz motor, 60 Hz supply. Speed rises 20%. A centrifugal pump or fan on that shaft asks for roughly 70% more power, and a 50 Hz 400 V rating does not simply carry over to 440 V 60 Hz. Buy the motor rated for the supply it will see and check the driven machine at the new speed.
NEMA frames. NEMA T-frames (143T, 182T, 256T and so on) are dimensioned in inches with different shaft heights and foot patterns. They are not IEC frames and the two do not interchange without an adapter base and a new coupling.

4. The EU rule, and what it did to replacements

Regulation (EU) 2019/1781 sets minimum efficiency classes to IEC 60034-30-1 for motors placed on the EU and EEA market. It covers three-phase induction motors, 2, 4, 6 and 8 poles, 50 V to 1,000 V, rated for continuous duty S1 or for S3 and S6 at 80% or more, from 0.12 kW to 1,000 kW.

From | Motor | Minimum class |

1 July 2021 | Three-phase, 0.12 kW up to 0.75 kW | IE2 |
1 July 2021 | Three-phase, 0.75 kW to 1,000 kW | IE3 |
1 July 2021 | Variable speed drives, 0.12 kW to 1,000 kW | IE2 to IEC 61800-9-2 |
1 July 2023 | Three-phase, 75 kW to 200 kW, 2, 4 or 6 poles, not brake motors, not Ex eb | IE4 |
1 July 2023 | Ex eb increased-safety motors, 0.12 kW to 1,000 kW | IE2 |
1 July 2023 | Single-phase motors, 0.12 kW and above | IE2 |

Outside the regulation: motors for ambient below minus 30 °C or above 60 °C, for altitude above 4,000 m, water-cooled with coolant below 0 °C or above 32 °C, motors with an inseparable integral brake, explosion-protected motors for mining, wound-rotor, DC and permanent-magnet motors, and motors above 1,000 V. The older route of an IE2 motor sold with a drive is closed.

Three consequences for a maintenance budget:

A failed IE1 or IE2 motor in scope is replaced by an IE3 or IE4. The replacement is cheaper to run and may be one frame up (section 3). Check the frame before the PO, not at the base.
Rewinding is not regulated. A rewind keeps the old frame and, done well, most of the old efficiency. For small motors a new IE3 is usually cheaper than a competent rewind; for large motors the rewind wins on price and lead time. Make the rule by frame size, in writing, so that it is not decided at 03:00.
The electricity bill dwarfs the purchase price. A motor running continuously consumes its own price in energy many times over its life. On motors that run all year, the efficiency figure at 75% load, where most motors live, is worth more than the discount.

The UK applies equivalent requirements under its own marking. Other markets have their own minimum classes; buy to the market where the motor will run, not where it was bought.

5. Efficiency, inverters and the motor as a system

IE classes come from IEC 60034-30-1 (line-fed) and IEC 60034-30-2 (converter-fed, which adds IE5). Efficiency is tested to IEC 60034-2-1.
An inverter changes the motor's duty. Standard motors run on drives in the common range; the questions are insulation suited to the drive's pulses, a PTC thermistor or PT100 in the winding, forced cooling if the motor will hold full torque at low speed, and a filter or short cable where the cable run is long.
Bearing currents. On larger frames, typically 280 and up, makers fit an insulated non-drive-end bearing for inverter duty, and a shaft-grounding device where the installation needs it. The threshold varies by maker; state "inverter-fed" on the RFQ line and it gets answered.
Power factor correction, soft starters and star-delta all depend on the connection on the plate. A 400 9B ò c“ Y motor star-delta-starts on 400 V; a 230 9B ò C Y motor does not.

6. Marine, offshore and hazardous-area motors

Ambient. Class rules, following IACS, take 45 °C air in machinery spaces and 32 °C seawater for cooling. A motor rated at 40 °C ambient is derated at 45 °C by the maker's table, usually a few percent, or bought with class F insulation and class B rise, which is the standard marine specification because the reserve absorbs the ambient.

Enclosure and finish. IP55 below deck, IP56 on weather decks and in wet spaces, with drain holes at the lowest point of the housing, anti-condensation heaters wired to a separate terminal, stainless or bronze fasteners and nameplates, and a marine paint system. Terminal boxes rotatable in 90° steps are worth specifying because the cable route on board rarely matches the catalogue drawing.

Inclination. Equipment on ships is designed to run at 22.5° static and 22.5° rolling, which decides bearing lubrication and the position of drain holes and heaters.

Class. Under IACS requirements, machines of 100 kW and above for essential services are surveyed by the classification society at test, and type or routine tests apply below that. State the vessel's society and whether the service is essential on the RFQ line, because it changes the paperwork and the lead time, not the motor.

Supply. Most ships run 440 V 60 Hz, some 690 V 60 Hz, and the older fleet 380 or 400 V 50 Hz. A replacement bought to the shore standard for a 60 Hz ship is the most common wrong motor delivered to a quay.

Hazardous areas. Ex db flameproof, Ex eb increased safety and Ex ec non-sparking motors carry ATEX and IECEx certificates, and the certificate number on the plate must match the paper. Since July 2023 Ex eb motors must be IE2. An Ex motor on an inverter is a certified combination, not two separate purchases.

7. Buying from a register, not from a failure

Motors fail a few at a time across a site, which is why they get bought one at a time, from whoever can ship fastest, at whatever price the night shift found. The fix is a motor register with one row per motor:

TAG equipment tag and location (plant area, or deck and compartment)
FRAME frame size with letter, mounting code
RATING kW, poles, voltage and connection, frequency, duty
ENCLOSURE IP, cooling, ambient, Ex marking if any, class requirement if any
DRIVE direct on line, star-delta, soft starter, inverter
COUPLING direct coupling, belt, gearbox, pump flange
BEARINGS DE and NDE designations, relubrication interval
STATUS installed year, efficiency class, rewinds to date, spare held (yes or no)

Three things fall out of the register:

A standing list by frame size. The register shows that a site with 400 motors runs on perhaps 25 frame-and-pole combinations, and that five of them cover most of the critical duties. Those are the spares to hold, one per combination, and the lines to price once a year.
A standardisation policy. One maker per frame range, so that spares, bearings, terminal boxes and drawings repeat, and like-for-fit remains possible when that maker is out of stock.
A replacement rule. Rewind above a stated frame, replace below it, replace any motor that has been rewound twice, and never replace a motor on an inverter or in a zoned area without the register row in front of you.

Standard IE3 motors in the common frames are stock items in distribution and move in days. Marine-specification, Ex, 60 Hz on a 50 Hz market, large frames and anything with class survey are made to order and run from weeks to months. The register tells you which of your motors are in the second group before one of them fails.

8. Documents to ask for with the motor

Dimension drawing with the terminal-box position; routine test report to IEC 60034-1; efficiency declaration at full, three-quarter and half load; EU declaration of conformity covering the Ecodesign regulation; ATEX and IECEx certificates where applicable; class society certificate or survey report for essential-service machines; bearing and lubrication data; spare parts list; a certificate of conformity referencing the purchase order. Ask on the RFQ line, before the order.

9. The cballast 9-line motor spec

Copy it, fill it in and send it to sales@cballast.com. It works with any supplier, and it is built so that one motor or a whole 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, vessel with IMO no., or project, or "we are the end user"
3. FRAME frame size with letter and mounting code, e.g. 160L IM B3
4. RATING kW, poles, voltage and connection, frequency, duty type
5. ENCLOSURE IP, cooling, ambient, Ex marking, class society and essential service if any
6. DRIVE AND LOAD line, star-delta, soft starter or inverter; direct, belt, gearbox or pump
7. EQUIVALENT OK? like-for-fit from any maker, or a named maker and type code
8. DOCUMENTS test report, efficiency declaration, Ex certificate, class certificate, drawing
9. DELIVERY address or port, need-by date, Incoterm; quantity, and annual quantity if recurring

What comes back from our desk: each line priced with frame, maker, type code, efficiency class and the actual efficiency figures, overall length and terminal-box position stated; any one-frame-up case flagged with the new foot dimensions; equivalents declared next to any requested maker, never swapped silently; lead time per line; documents per line as asked.

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. 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: ship owners and managers, water and wastewater utilities, process plants, 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 an IEC motor with another maker's motor of the same frame size?Yes, when frame size with its letter, mounting

code, pole count, rated output, voltage, frequency, enclosure and efficiency class match. IEC 60072-1 fixes the shaft height, shaft diameter, foot pattern and flange for each frame, so the mounting is interchangeable. Check overall length, terminal-box position, weight and, on 2-pole motors from frame 225, the shaft diameter.What does a motor frame size such as 132M mean?A shaft centre height of 132 mm with the medium foot-hole spacing: feet 216 mm across and 178 mm along the shaft, a 38 mm shaft, and an FF265 flange in the B5 version.Which motor efficiency class is mandatory in the EU?Under Regulation (EU) 2019/1781: IE3 for three-phase motors from 0.75 to 1,000 kW since July 2021, IE4 for 75 to 200 kW 2-, 4- and 6-pole motors since July 2023, and IE2 for 0.12 to 0.75 kW, for Ex eb motors and for single-phase motors.Why is the new IE3 motor a bigger frame than the IE1 it replaces?Higher efficiency takes more copper and iron. Many makers keep the conventional frame for a given power; some move it one frame up, which changes the foot pattern. Ask for the frame size on every replacement quote and measure the old base.Are NEMA and IEC motor frames interchangeable?No. NEMA T-frames are dimensioned in inches with different shaft heights and foot patterns. Replacing one with the other needs an adapter base and a new coupling.Which motors need class approval on a ship?Under IACS requirements, machines of 100 kW and above for essential services are surveyed by the classification society at test; smaller essential-service machines are covered by type and routine tests. Marine motors are also specified for 45 °C ambient, IP55 or IP56, class F insulation with class B rise and 22.5° inclination.Does cballast supply electric motors?Yes. Low-voltage three-phase IEC motors by frame size or by maker type code, including marine, Ex and inverter-duty specifications, together with the bearings, couplings, drives and switchgear around them, within a catalogue of 336,000+ part numbers from 1,000+ brands. Send the 9-line spec or a motor register to sales@cballast.com.What is cballast not the right source for?Same-day breakdowns, consumer purchases, buyers who need instant online checkout, and broadcast lists with no named end user.What payment terms does cballast offer?New accounts are vetted and the first order is prepaid. Established accounts get credit terms and repeat-account discounts.

Terms used in this guide

Frame size: the IEC 60072-1 designation, shaft height in millimetres plus S, M or L for the foot-hole spacing.
The frame is the contract: the frame, not the maker, fixes the mounting dimensions.
Like-for-fit: a replacement motor that matches frame, mounting, poles, rating, voltage, frequency, enclosure and efficiency class from any maker; as opposed to like-for-like, the same maker and type code.
One frame up: the case where a higher efficiency class moves a given power to the next frame size.
Motor register: one row per installed motor with the fields in section 7.
Standing list: the frame-and-pole combinations a site holds as spares and prices once a year.
9-line motor spec: the cballast RFQ format in section 9.
Identifier-first sourcing: choosing the supply route from the number you hold, here the frame designation, rather than from a description.

References and related guides

Standards and sources referenced: IEC 60072-1; EN 50347; IEC 60034-1, -2-1, -5, -6, -7, -30-1, -30-2; IEC 61800-9-2; Regulation (EU) 2019/1781; IACS unified requirements (ambient, inclination, survey); ATEX 2014/34/EU and IECEx; NEMA MG 1.
IEC motor frame size chart (full dimension table)
IEC 60034-30 motor efficiency classes IE1–IE5
IEC 60034 motor duty classes S1–S10
Variable frequency drive cross-reference by kW and voltage
Motor protection circuit breaker cross-reference
Buying bearings by designation — the suffix translator

Questions on a nameplate, a one-frame-up case, a 50 to 60 Hz move, or how to set up a register are welcome at sales@cballast.com. We answer whether or not you buy from us. Motor specs and registers go to sales@cballast.com.

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