



# Electric Motors High Efficiency



# IE3

## PREMIUM EFFICIENCY





# INTRODUCTION

The conservative and responsible use of energy to save resources, to reduce the amount of CO<sub>2</sub> emissions and to decrease energy costs is the order of the day. The electrical drive system plays a key role in this process. Electrical drives form the link between the electrical energy supply and the majority of mechanical processes, which require a large amount of energy. Machines driven by electrical motors consume 2/3 of all the electrical energy used in industry. If the old systems in German industry, commerce and public facilities, which have been running for decades, were all replaced by modern drive systems, this would result in annual energy savings of 38 billion kilowatt hours. Calculated for all of Europe, this figure would be 135 billion kilowatt hours.

By using electronic speed control and Energy efficient motors, Europe's CO<sub>2</sub> emissions could be reduced by 69 million tonnes.

This brochure describes the new standardised international efficiency classes for standard three-phase motors, the new measuring methods and the requirements stipulated by the European Regulation 640/2009 of the European Commission for energy efficiency in motors and drive systems.

This brochure also offers an overview of some of the world-wide existing national legislation and addresses subjects like material composition and life cycle cost.

The catalogue is written for users, original equipment manufacturers (OEM), machine manufacturers and motor and drive system manufacturers.

## Efficiency Classes of Motors and Measuring Methods

The "efficiency" describes how efficiently an electric motor transforms electrical energy into mechanical energy. Previously in Europe, low voltage three-phase motors have been graded and marketed in three efficiency classes – EFF3, EFF2 and EFF1 – based on a voluntary agreement between motor manufacturers and the European Commission.

This classification system is well proven and has now been adapted in many countries around the world. Unfortunately, other countries have also developed their own national systems, which are very different from the European system. That was the reason for the German motor manufacturers in ZVEI, with the support of their European neighbours, to develop an energy efficiency standard for the International Electrotechnical Commission (IEC).

The objective was to have a common international standard that replaces all the different national systems.

This project was successful and the objective has been met.

The new international standard, IEC 60034-30:2008, defines efficiency classes IE1, IE2 and IE3 for three-phase motors.

This ensures a common international basis for the design and classification of motors as well as for national legislative activities. At the same time, the IEC developed improved methods for determining the efficiency of these motors.

The international standards IEC 60034-30:2008 (classification) and IEC 60034-2-1:2007 (measuring methods) have been adopted as European standards without any changes as EN 60034-30:2009 and EN 60034-2-1:2007.

For the sake of simplicity, the following sections will refer to the IEC standards only.

### **Previous efficiency classes of motors in Europe**

In 1998, as part of the voluntary agreement between the European sector committee of Manufacturers of Electrical Machines and Power Electronics (CEMEP) and the European Commission, three efficiency classes were defined for the power range of 1.1 kW to 90 kW:

- EFF3 = Motors with a low efficiency level
- EFF2 = Motors with an improved efficiency level
- EFF1 = Motors with a high efficiency level

### **New international standard for efficiency classes of motors (IE-code)**

This voluntary agreement has since expired. However, the efficiency classes remain a registered European trademark. Use of the efficiency classes is based on a contractual licensing agreement between the participants in the voluntary agreement (motor manufacturers) and the license holder (CEMEP / Gimelec). This licensing agreement expires on 10 February 2010, but can be extended to 15 June 2011 upon request.

Standard IEC 60034-30:2008 defines the efficiency classes for low voltage three-phase motors with a power range from 0.75 kW to 375 kW. "IE" stands for "International Efficiency" and is combined with a number:

IE1 = Standard efficiency

IE2 = High efficiency

IE3 = Premium efficiency

### **New IEC measuring methods**

The new measuring methods in accordance with IEC 60034-2-1:2007 (standard methods for determining losses and efficiency from tests) apply for all motors described by IEC 60034-1. These methods help to generate more exact data regarding stray load loss. The new standard replaces the previous European standard EN 60034-2:1996, which expired on 1 November 2010. Motors that are marked according to the new efficiency class system (IE-code) are required to be measured using the new measurement methods.

### **Comparison of old and new efficiency classes**

The new international efficiency class system (IE-code) has an open numbering system. Compared to the old EFF efficiency classes, it is now easier to add future developments. In addition, there is a new class – IE3 – which did not exist in the old European EFF classification system.

The scope has also been extended significantly; the new IE-code applies to a larger power range as well as for the 60 Hz classes e.g. in the USA.

The main difference between the efficiency classes (EFF and IE) lies in the method used to determine them. In a direct comparison at the same motor, it is expected that the efficiency determined according to the new measuring method will be lower. For example, an 11 kW, 4-pole EFF1 motor with 91.0% efficiency is physically identical with a IE2 motor with 89.8% efficiency.

### Scope of new IEC efficiency class system (IE-code)

The efficiency class system specified under IEC 60034-30 is valid for low voltage three-phase cage induction motors with the following specifications:

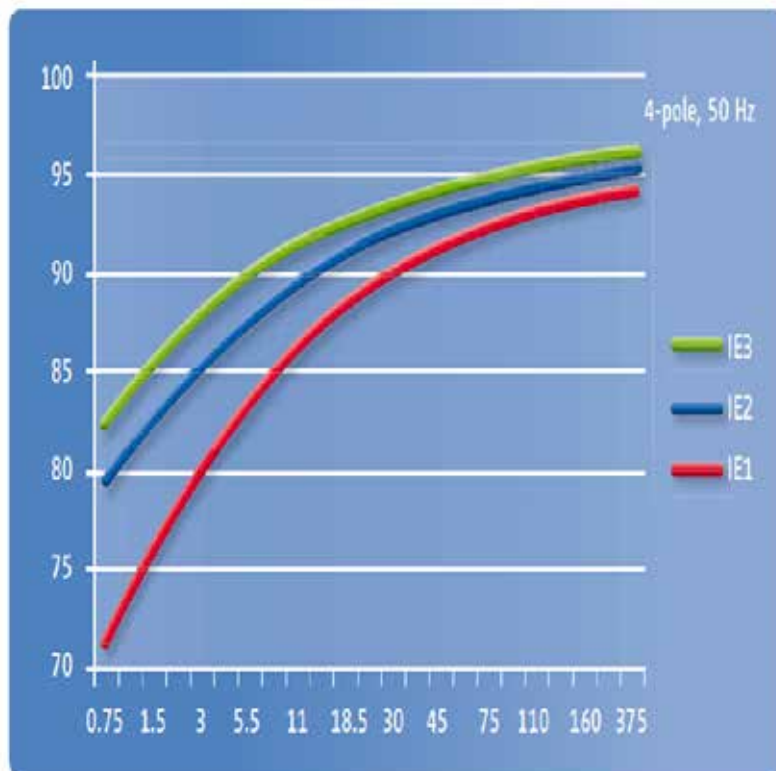
- Rated voltage up to 1,000 V
- Rated output between 0.75 kW and 375 kW
- Either 2, 4 or 6 poles
- Rated on the basis of continuous duty (S1) or intermittent periodic duty (S3) with cyclic duration factor of 80% or higher;
- Capable of operating direct on-line
- Rated for operating conditions in accordance with IEC 60034-1 (temperature, installation altitude, etc.)

Motors with flanges, feet and/or shafts with mechanical dimensions different from IEC 60072-1 are covered by this standard.

Geared motors and brake motors are covered by this standard, although special shafts and flanges may be used in such motors.

Some motors covered by this standard may be equipped with auxiliary devices. However, as long as these auxiliary devices are not an integral part of the motor construction, the determination of efficiency in all possible combinations is not practical. Determinations for efficiency of such modified standard motors shall be performed on basic motors without auxiliary devices installed. The following are exceptions to the classification system:

- Motors for short-time duty (S2) or switching operation (S3 < 80% to S10);
- Motors that were solely designed for converter operation (VSD) in accordance with IEC 60034-25 as well as
- Motors that have a highly specialized design customized for one particular application in such a way that it is not possible to measure the motor on its own (for example pump motors with wet rotors).



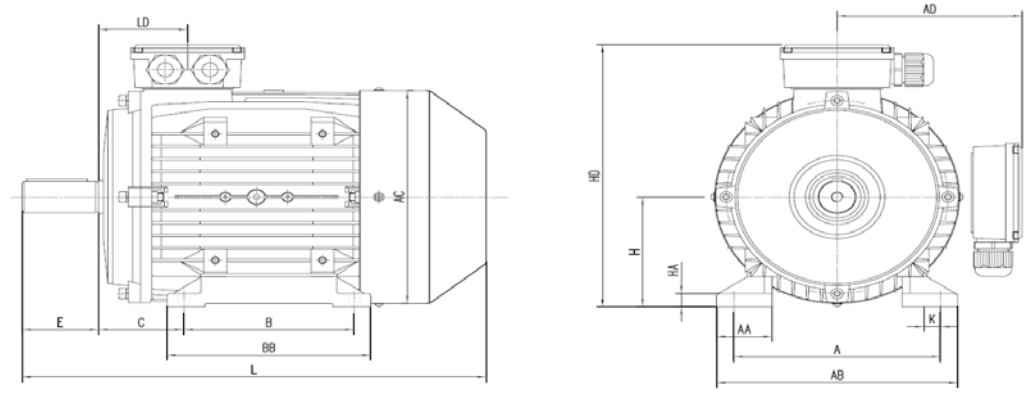
# IE3 ALUMINIUM HOUSING - TECHNICAL DATA

| TYPE        | Power KW | RPM r/min | Voltage |     | Amp   | Amp  | Efficiency 100% | Efficiency 75% | Efficiency 50% | Power Factor cosφ 100 % | Locked Current Is/In | Locked Torque Ts/Tn | Locked Torque Tm/Tn | Moment of inertia Kgm2 | Weight Kg. |
|-------------|----------|-----------|---------|-----|-------|------|-----------------|----------------|----------------|-------------------------|----------------------|---------------------|---------------------|------------------------|------------|
| FA3-80 1-2  | 0,75     | 2820      | 230     | 400 | 2,82  | 1,63 | 80,7            | 81,0           | 79,7           | 0,831                   | 6,0                  | 2,3                 | 2,3                 | 0,001                  | 9,5        |
| FA3-80 2-2  | 1,1      | 2820      | 230     | 400 | 4,00  | 2,30 | 82,7            | 82,9           | 81,5           | 0,836                   | 7,5                  | 2,3                 | 2,3                 | 0,002                  | 11         |
| FA3-90S-2   | 1,5      | 2840      | 230     | 400 | 5,23  | 3,02 | 84,2            | 85,0           | 84,0           | 0,857                   | 7,5                  | 2,4                 | 2,4                 | 0,002                  | 15         |
| FA3-90L-2   | 2,2      | 2840      | 230     | 400 | 7,44  | 4,30 | 85,9            | 86,5           | 86,0           | 0,865                   | 7,5                  | 2,4                 | 2,4                 | 0,003                  | 18         |
| FA3-100L-2  | 3        | 2850      | 230     | 400 | 9,90  | 5,72 | 87,1            | 87,3           | 86,2           | 0,873                   | 8,0                  | 2,4                 | 2,4                 | 0,005                  | 25         |
| FA3-112M-2  | 4        | 2870      | 400     | 690 | 7,48  | 4,32 | 88,1            | 88,4           | 88,0           | 0,88                    | 8,5                  | 2,4                 | 2,4                 | 0,008                  | 28,5       |
| FA3-132S1-2 | 5,5      | 2900      | 400     | 690 | 10,00 | 5,80 | 89,2            | 89,6           | 89,1           | 0,89                    | 7,5                  | 2,2                 | 2,4                 | 0,014                  | 41         |
| FA3-132S2-2 | 7,5      | 2900      | 400     | 690 | 13,50 | 7,80 | 90,1            | 90,5           | 90,0           | 0,892                   | 7,5                  | 2,2                 | 2,4                 | 0,017                  | 46,5       |

| TYPE        | Power KW | RPM r/min | Voltage |     | Amp   | Amp  | Efficiency 100% | Efficiency 75% | Efficiency 50% | Power Factor cosφ | Locked Current Is/In | Locked Torque Ts/Tn | Locked Torque Tm/Tn | Moment of inertia Kgm2 | Weight Kg. |
|-------------|----------|-----------|---------|-----|-------|------|-----------------|----------------|----------------|-------------------|----------------------|---------------------|---------------------|------------------------|------------|
| FA3-80 2-4  | 0,75     | 1400      | 230     | 400 | 2,97  | 1,72 | 82,5            | 82,7           | 81,0           | 0,77              | 7,00                 | 2,4                 | 2,4                 | 0,003                  | 12         |
| FA3-90S-4   | 1,1      | 1420      | 230     | 400 | 4,25  | 2,45 | 84,1            | 84,3           | 82,6           | 0,775             | 7,50                 | 2,4                 | 2,4                 | 0,004                  | 16         |
| FA3-90L-4   | 1,5      | 1420      | 230     | 400 | 5,68  | 3,28 | 85,3            | 85,4           | 83,8           | 0,778             | 8,00                 | 2,4                 | 2,4                 | 0,054                  | 20         |
| FA3-100L1-4 | 2,2      | 1440      | 230     | 400 | 8,00  | 4,62 | 86,7            | 86,8           | 84,3           | 0,798             | 8,00                 | 2,4                 | 2,4                 | 0,010                  | 26         |
| FA3-100L2-4 | 3        | 1440      | 230     | 400 | 10,80 | 6,20 | 87,7            | 87,8           | 86,0           | 0,801             | 8,00                 | 2,4                 | 2,4                 | 0,013                  | 30         |
| FA3-112M-4  | 4        | 1450      | 400     | 690 | 7,97  | 4,60 | 88,6            | 88,8           | 88,3           | 0,821             | 7,50                 | 2,4                 | 2,4                 | 0,020                  | 38         |
| FA3-132S-4  | 5,5      | 1450      | 400     | 690 | 10,80 | 6,24 | 89,6            | 89,7           | 89,0           | 0,825             | 7,50                 | 2,3                 | 2,4                 | 0,035                  | 46         |
| FA3-132M-4  | 7,5      | 1450      | 400     | 690 | 14,40 | 8,32 | 90,4            | 90,6           | 90,1           | 0,834             | 7,50                 | 2,3                 | 2,4                 | 0,047                  | 54         |

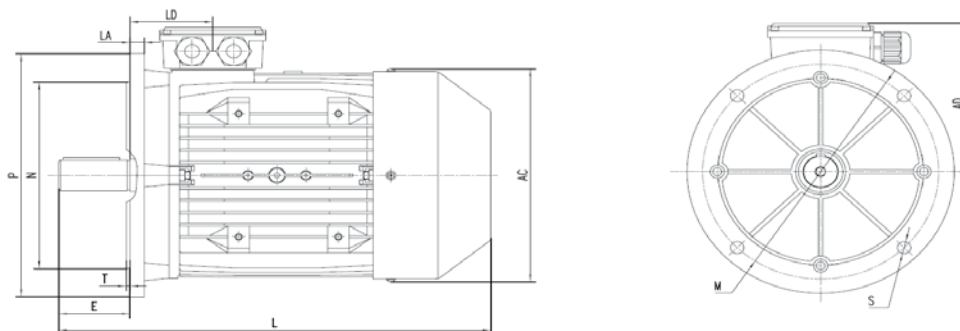
| TYPE        | Power KW | RPM r/min | Voltage |     | Amp   | Amp  | Efficiency 100% | Efficiency 75% | Efficiency 50% | Power Factor cosφ | Locked Current Is/In | Locked Torque Ts/Tn | Locked Torque Tm/Tn | Moment of inertia Kgm2 | Weight Kg. |
|-------------|----------|-----------|---------|-----|-------|------|-----------------|----------------|----------------|-------------------|----------------------|---------------------|---------------------|------------------------|------------|
| FA3-90S-6   | 0,75     | 910       | 230     | 400 | 3,42  | 1,97 | 78,9            | 79,4           | 77,5           | 0,7               | 4,00                 | 2,0                 | 2,3                 | 0,005                  | 15         |
| FA3-90L-6   | 1,1      | 910       | 230     | 400 | 4,80  | 2,78 | 81,0            | 81,3           | 80,2           | 0,71              | 4,00                 | 2,0                 | 2,3                 | 0,008                  | 20         |
| FA3-100L-6  | 1,5      | 930       | 230     | 400 | 6,35  | 3,66 | 82,5            | 82,6           | 81,3           | 0,72              | 5,00                 | 2,0                 | 2,3                 | 0,013                  | 25         |
| FA3-112M-6  | 2,2      | 940       | 230     | 400 | 8,98  | 5,20 | 84,3            | 85,0           | 83,2           | 0,73              | 5,00                 | 2,0                 | 2,3                 | 0,020                  | 30         |
| FA3-132S-6  | 3        | 960       | 230     | 400 | 11,90 | 6,87 | 85,6            | 85,8           | 84,5           | 0,74              | 6,50                 | 2,2                 | 2,3                 | 0,037                  | 38,5       |
| FA3-132M1-6 | 4        | 960       | 400     | 690 | 9,00  | 5,20 | 86,8            | 86,9           | 85,3           | 0,745             | 7,00                 | 2,2                 | 2,3                 | 0,050                  | 47,5       |
| FA3-132M2-6 | 5,5      | 960       | 400     | 690 | 12,10 | 7,00 | 88,0            | 88,2           | 86,9           | 0,75              | 7,00                 | 2,2                 | 2,3                 | 0,065                  | 58         |

## IMB3 - IE3 - ALUMINIUM



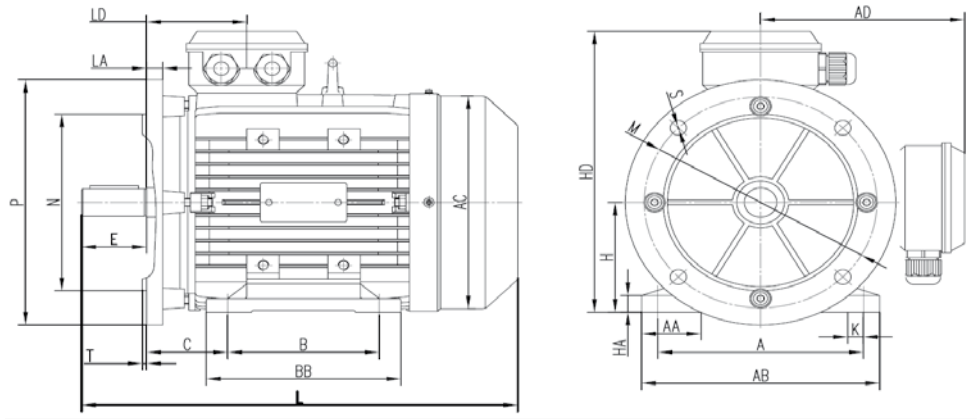
| Frame Size | Pole | Dimensions |     |    |              |    |  | Dimensions |     |     |     |     |    |              |    |     |
|------------|------|------------|-----|----|--------------|----|--|------------|-----|-----|-----|-----|----|--------------|----|-----|
|            |      | A          | B   | C  | H            | K  |  | AA         | AB  | AC  | AD  | BB  | HA | HD<br>on top | LD | L   |
| 80         | 2-6  | 125        | 100 | 50 | 80°<br>-0,5  | 10 |  | 35         | 155 | 157 | 125 | 125 | 12 | 205          | 65 | 295 |
| 90S        | 2-6  | 140        | 100 | 56 | 90°<br>-0,5  | 10 |  | 37         | 180 | 177 | 138 | 155 | 14 | 228          | 66 | 355 |
| 90L        | 2-6  | 140        | 125 | 56 | 90°<br>-0,5  | 10 |  | 37         | 180 | 177 | 138 | 155 | 14 | 228          | 66 | 385 |
| 100L       | 2-6  | 160        | 140 | 63 | 100°<br>-0,5 | 12 |  | 45         | 200 | 205 | 150 | 180 | 14 | 250          | 85 | 440 |
| 112M       | 2-6  | 190        | 140 | 70 | 112°<br>-0,5 | 12 |  | 55         | 225 | 220 | 172 | 180 | 14 | 284          | 88 | 405 |
| 132S       | 2-8  | 216        | 140 | 89 | 132°<br>-0,5 | 12 |  | 58         | 255 | 256 | 192 | 176 | 14 | 324          | 94 | 455 |
| 132M       | 2-8  | 216        | 178 | 89 | 132°<br>-0,5 | 12 |  | 58         | 255 | 256 | 192 | 215 | 14 | 324          | 94 | 490 |

## IMB5 - IE3 - ALUMINIUM



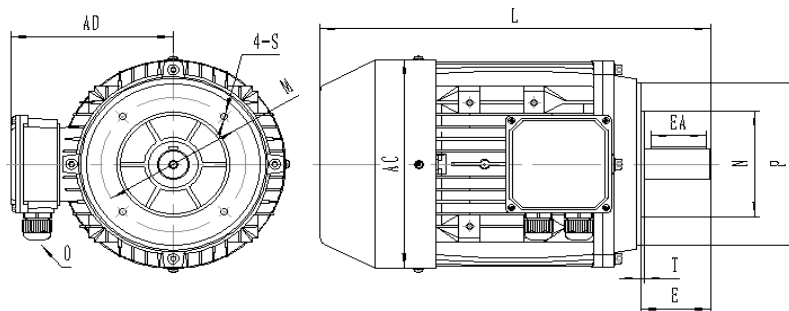
| Frame Size | Pole | Dimensions |     |     |       |   | Dimensions |     |    |    |     |  |
|------------|------|------------|-----|-----|-------|---|------------|-----|----|----|-----|--|
|            |      | M          | N   | P   | S     | T | AC         | AD  | LA | LD | L   |  |
| 80         | 2-8  | 165        | 130 | 200 | 4-Φ12 | 4 | 157        | 125 | 12 | 65 | 295 |  |
| 90S        | 2-8  | 165        | 130 | 200 | 4-Φ12 | 4 | 177        | 138 | 12 | 66 | 355 |  |
| 90L        | 2-8  | 165        | 130 | 200 | 4-Φ12 | 4 | 177        | 138 | 12 | 66 | 385 |  |
| 100L       | 2-8  | 215        | 180 | 250 | 4-Φ15 | 4 | 205        | 150 | 14 | 85 | 440 |  |
| 112M       | 2-8  | 215        | 180 | 250 | 4-Φ15 | 4 | 220        | 172 | 14 | 88 | 405 |  |
| 132S       | 2-8  | 265        | 230 | 300 | 4-Φ15 | 4 | 256        | 192 | 15 | 94 | 455 |  |
| 132M       | 2-8  | 265        | 230 | 300 | 4-Φ15 | 4 | 256        | 192 | 15 | 94 | 490 |  |

## IMB35 - IE3 - ALUMINIUM



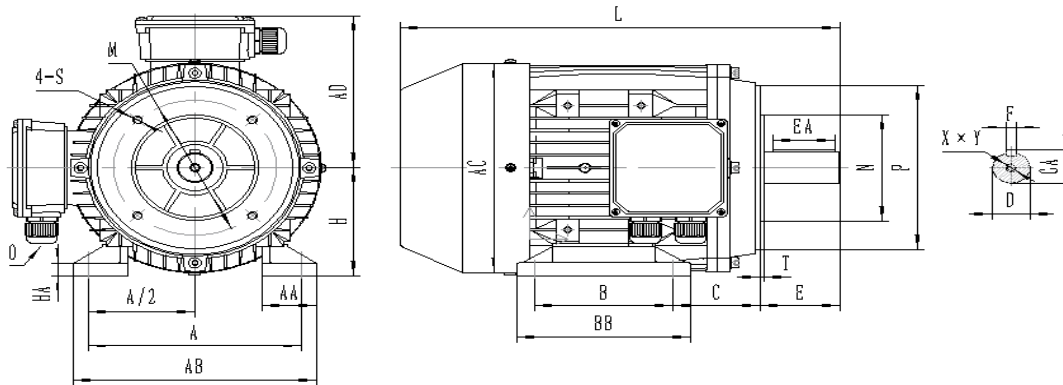
| Frame Size | Pole | Dimensions |     |    |                      |    |     |     |     |       |   | Dimensions |     |     |     |     |    |     |     |    |    |     |
|------------|------|------------|-----|----|----------------------|----|-----|-----|-----|-------|---|------------|-----|-----|-----|-----|----|-----|-----|----|----|-----|
|            |      | A          | B   | C  | H                    | K  | M   | N   | P   | S     | T | AA         | AB  | AC  | AD  | BB  | HA | HD  |     | LA | LD | L   |
|            |      |            |     |    |                      |    |     |     |     |       |   |            |     |     |     |     |    | Top | L&R |    |    |     |
| 80         | 2-6  | 125        | 100 | 50 | 80° <sub>-0,5</sub>  | 10 | 165 | 130 | 200 | 4-Φ12 | 4 | 35         | 155 | 157 | 125 | 125 | 12 | 205 | 125 | 12 | 65 | 295 |
| 90S        | 2-6  | 140        | 100 | 56 | 90° <sub>-0,5</sub>  | 10 | 165 | 130 | 200 | 4-Φ12 | 4 | 37         | 180 | 177 | 138 | 155 | 14 | 228 | 138 | 12 | 66 | 355 |
| 90L        | 2-6  | 140        | 125 | 56 | 90° <sub>-0,5</sub>  | 10 | 165 | 130 | 200 | 4-Φ12 | 4 | 37         | 180 | 177 | 138 | 155 | 14 | 228 | 138 | 12 | 66 | 385 |
| 100L       | 2-6  | 160        | 140 | 63 | 100° <sub>-0,5</sub> | 12 | 215 | 180 | 250 | 4-Φ15 | 4 | 45         | 200 | 205 | 150 | 180 | 14 | 250 | 150 | 14 | 85 | 440 |
| 112M       | 2-6  | 190        | 140 | 70 | 112° <sub>-0,5</sub> | 12 | 215 | 180 | 250 | 4-Φ15 | 4 | 55         | 225 | 220 | 172 | 180 | 14 | 284 | 172 | 14 | 88 | 405 |
| 132S       | 2-6  | 216        | 140 | 89 | 132° <sub>-0,5</sub> | 12 | 265 | 230 | 300 | 4-Φ15 | 4 | 58         | 255 | 256 | 192 | 176 | 14 | 324 | 192 | 15 | 94 | 455 |
| 132M       | 2-6  | 216        | 178 | 89 | 132° <sub>-0,5</sub> | 12 | 265 | 230 | 300 | 4-Φ15 | 4 | 58         | 255 | 256 | 192 | 215 | 14 | 324 | 192 | 15 | 94 | 490 |

## IMB14 - IE3 - ALUMINIUM



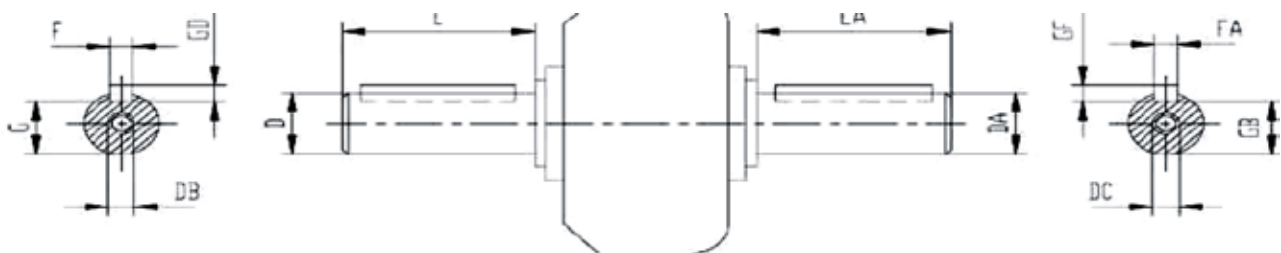
| Frame Size | Pole | Dimensions |     |     |       |     | Dimensions |     |     |
|------------|------|------------|-----|-----|-------|-----|------------|-----|-----|
|            |      | M          | N   | P   | S     | T   | AC         | AD  | L   |
| 80         | 2-8  | 100        | 80  | 120 | 4-M6  | 3   | 157        | 125 | 295 |
| 90S        | 2-8  | 115        | 95  | 140 | 4-M8  | 3   | 177        | 138 | 355 |
| 90L        | 2-8  | 115        | 95  | 140 | 4-M8  | 3   | 177        | 138 | 385 |
| 100L       | 2-8  | 130        | 110 | 160 | 4-M8  | 3,5 | 205        | 150 | 440 |
| 112M       | 2-8  | 130        | 110 | 160 | 4-M8  | 3,5 | 220        | 172 | 405 |
| 132S       | 2-8  | 165        | 130 | 200 | 4-M10 | 4   | 256        | 192 | 455 |
| 132M       | 2-8  | 165        | 130 | 200 | 4-M10 | 4   | 256        | 192 | 490 |

## IMB34 - IE3 - ALUMINIUM



| Frame Size | Pole | Dimensions |      |     |    |                      |    |     |     |     |       |     |    | Dimensions |     |     |     |    |     |     |     |  |  |
|------------|------|------------|------|-----|----|----------------------|----|-----|-----|-----|-------|-----|----|------------|-----|-----|-----|----|-----|-----|-----|--|--|
|            |      | A          | A/2  | B   | C  | H                    | K  | M   | N   | P   | S     | T   | AA | AB         | AC  | AD  | BB  | HA | HD  |     | L   |  |  |
|            |      |            |      |     |    |                      |    |     |     |     |       |     |    |            |     |     |     |    | Top | L&R |     |  |  |
| 80         | 2-6  | 125        | 62,5 | 100 | 50 | 80° <sub>-0,5</sub>  | 10 | 100 | 80  | 120 | 4-M6  | 3   | 35 | 155        | 157 | 125 | 125 | 12 | 205 | 125 | 295 |  |  |
| 90S        | 2-6  | 140        | 70   | 100 | 56 | 90° <sub>-0,5</sub>  | 10 | 115 | 95  | 140 | 4-M8  | 3   | 37 | 180        | 177 | 138 | 155 | 14 | 228 | 138 | 355 |  |  |
| 90L        | 2-6  | 140        | 70   | 125 | 56 | 90° <sub>-0,5</sub>  | 10 | 115 | 95  | 140 | 4-M8  | 3   | 37 | 180        | 177 | 138 | 155 | 14 | 228 | 138 | 385 |  |  |
| 100L       | 2-6  | 160        | 80   | 140 | 63 | 100° <sub>-0,5</sub> | 12 | 130 | 110 | 160 | 4-M8  | 3,5 | 45 | 200        | 205 | 150 | 180 | 14 | 250 | 150 | 440 |  |  |
| 112M       | 2-6  | 190        | 95   | 140 | 70 | 112° <sub>-0,5</sub> | 12 | 130 | 110 | 160 | 4-M8  | 3,5 | 55 | 225        | 220 | 172 | 180 | 14 | 284 | 172 | 405 |  |  |
| 132S       | 2-6  | 216        | 108  | 140 | 89 | 132° <sub>-0,5</sub> | 12 | 165 | 130 | 200 | 4-M10 | 4   | 58 | 255        | 256 | 192 | 176 | 14 | 324 | 192 | 455 |  |  |
| 132M       | 2-6  | 216        | 108  | 178 | 89 | 132° <sub>-0,5</sub> | 12 | 165 | 130 | 200 | 4-M10 | 4   | 58 | 255        | 256 | 192 | 215 | 14 | 324 | 192 | 490 |  |  |

## DIMENSIONE ALBERO - DIMENSION SHAFT



| Frame | Pole  | D                                             | DA                                            | E  | EA | F  | FA | G     | GB    | GD | GF | DB  | DC  |
|-------|-------|-----------------------------------------------|-----------------------------------------------|----|----|----|----|-------|-------|----|----|-----|-----|
| 80    | 2-4-6 | 19 j6 <sup>(+0.009)</sup> <sub>(-0.004)</sub> | 19 j6 <sup>(+0.009)</sup> <sub>(-0.004)</sub> | 40 | 40 | 6  | 6  | 15:05 | 15:05 | 6  | 6  | M6  | M6  |
| 90S   | 2-4-6 | 24 j6 <sup>(+0.009)</sup> <sub>(-0.004)</sub> | 24 j6 <sup>(+0.009)</sup> <sub>(-0.004)</sub> | 50 | 50 | 8  | 8  | 20    | 20    | 7  | 7  | M8  | M8  |
| 90L   | 2-4-6 |                                               |                                               |    |    |    |    |       |       |    |    |     |     |
| 100L  | 2-4-6 | 28 j6 <sup>(+0.009)</sup> <sub>(-0.004)</sub> | 28 j6 <sup>(+0.009)</sup> <sub>(-0.004)</sub> | 60 | 60 |    |    | 24    | 24    |    |    | M10 | M10 |
| 112M  | 2-4-6 |                                               |                                               |    |    |    |    |       |       |    |    |     |     |
| 132S  | 2-4-6 | 38 k6 <sup>(+0.018)</sup> <sub>(-0.002)</sub> | 38 k6 <sup>(+0.018)</sup> <sub>(-0.002)</sub> | 80 | 80 | 10 | 10 | 33    | 33    | 8  | 8  | M12 | M12 |
| 132M  | 2-4-6 |                                               |                                               |    |    |    |    |       |       |    |    |     |     |

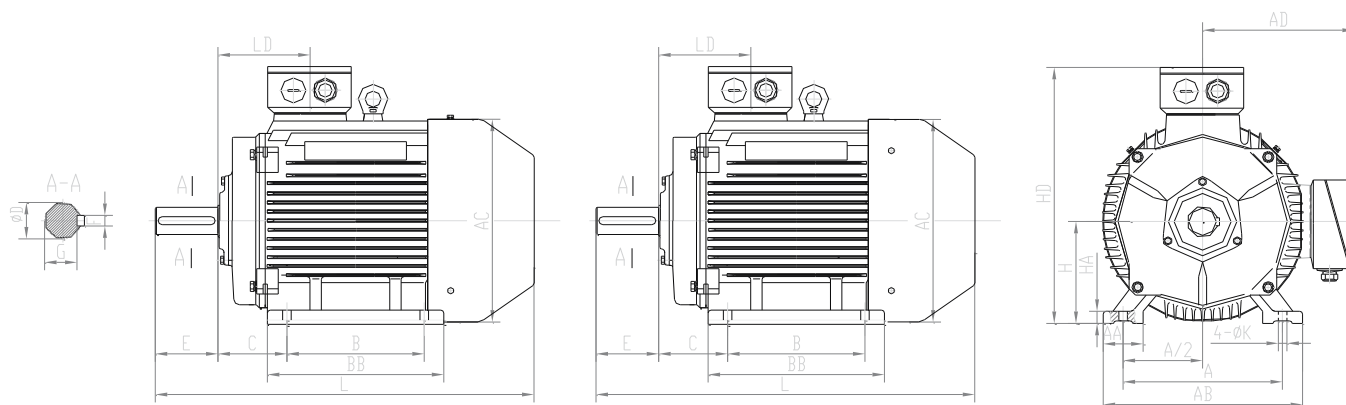
# IE3 CASTI RON HOUSING - TECHNICAL DATA

| TYPE              | Power KW  | RPM r/min   | Voltage    |            | Amp         | Amp         | Efficiency 100% | Efficiency 75% | Efficiency 50% | Power Factor cosφ 100 % | Locked Current Is/In | Locked Torque Ts/Tn | Locked Torque Tm/Tn | Moment of inertia Kgm2 | Weight Kg. |
|-------------------|-----------|-------------|------------|------------|-------------|-------------|-----------------|----------------|----------------|-------------------------|----------------------|---------------------|---------------------|------------------------|------------|
| F3 160M-2         | 11        | 2940        | 400        | 690        | 20,0        | 11,6        | 91,2            | 91,3           | 88,5           | 0,87                    | 8,10                 | 2,00                | 2,30                | 0,051                  | 125        |
| F3 160MX-2        | 15        | 2940        | 400        | 690        | 27,1        | 15,7        | 91,9            | 92,0           | 89,1           | 0,87                    | 8,10                 | 2,00                | 2,30                | 0,064                  | 136        |
| F3 160L-2         | 18,5      | 2940        | 400        | 690        | 33,2        | 19,3        | 92,4            | 92,5           | 89,6           | 0,87                    | 8,20                 | 2,00                | 2,30                | 0,076                  | 148        |
| F3 180M-2         | 22        | 2950        | 400        | 690        | 38,9        | 22,6        | 92,7            | 92,8           | 89,9           | 0,88                    | 8,20                 | 2,00                | 2,30                | 0,117                  | 189        |
| F3 200L-2         | 30        | 2955        | 400        | 690        | 52,7        | 30,6        | 93,3            | 93,4           | 90,5           | 0,88                    | 7,60                 | 2,00                | 2,30                | 0,174                  | 242        |
| <b>F3 200LX-2</b> | <b>37</b> | <b>2955</b> | <b>400</b> | <b>690</b> | <b>65,5</b> | <b>38,0</b> | <b>93,7</b>     | <b>93,8</b>    | <b>90,9</b>    | <b>0,87</b>             | <b>7,60</b>          | <b>2,00</b>         | <b>2,30</b>         | <b>0,205</b>           | <b>270</b> |
| F3 225M-2         | 45        | 2960        | 400        | 690        | 77,6        | 45,0        | 94,0            | 94,1           | 91,2           | 0,89                    | 7,70                 | 2,00                | 2,30                | 0,302                  | 328        |
| F3 250M-2         | 55        | 2965        | 400        | 690        | 95,7        | 55,5        | 94,3            | 94,4           | 91,5           | 0,88                    | 7,70                 | 2,00                | 2,30                | 0,408                  | 414        |
| F3 280S-2         | 75        | 2975        | 400        | 690        | 129,9       | 75,3        | 94,7            | 94,8           | 91,9           | 0,88                    | 7,10                 | 1,80                | 2,30                | 0,799                  | 541        |
| F3 280M-2         | 90        | 2975        | 400        | 690        | 153,6       | 89,1        | 94,7            | 94,8           | 91,9           | 0,89                    | 7,10                 | 1,80                | 2,30                | 1,071                  | 645        |
| F3 315S-2         | 110       | 2980        | 400        | 690        | 183,3       | 106,2       | 95,2            | 95,3           | 92,3           | 0,91                    | 7,10                 | 1,80                | 2,30                | 2,031                  | 900        |
| F3 315M-2         | 132       | 2980        | 400        | 690        | 219,5       | 127,2       | 95,4            | 95,5           | 92,5           | 0,91                    | 7,10                 | 1,80                | 2,30                | 2,207                  | 1025       |
| F3 315L-2         | 160       | 2980        | 400        | 690        | 265,5       | 153,9       | 95,6            | 95,7           | 92,7           | 0,91                    | 7,20                 | 1,80                | 2,30                | 2,487                  | 1160       |
| F3 315LX-2        | 200       | 2980        | 400        | 690        | 331,1       | 192,0       | 95,8            | 95,9           | 92,9           | 0,91                    | 7,20                 | 1,80                | 2,20                | 2,907                  | 1160       |
| F3 355M-2         | 250       | 2980        | 400        | 690        | 413,9       | 240,0       | 95,8            | 95,9           | 92,9           | 0,91                    | 7,20                 | 1,60                | 2,20                | 3,812                  | 1625       |
| F3 355LX-2        | 315       | 2980        | 400        | 690        | 521,5       | 302,3       | 95,8            | 95,9           | 92,9           | 0,91                    | 7,20                 | 1,60                | 2,20                | 4,463                  | 1750       |
| F3 355LY-2        | 355       | 2980        | 400        | 690        | 587,8       | 340,7       | 95,8            | 95,9           | 92,9           | 0,91                    | 7,20                 | 1,60                | 2,20                | 4,463                  | 1740       |

| TYPE       | Power KW | RPM r/min | Voltage |     | Amp   | Amp   | Efficiency 100% | Efficiency 75% | Efficiency 50% | Power Factor cosφ | Locked Current Is/In | Locked Torque Ts/Tn | Locked Torque Tm/Tn | Moment of inertia Kgm2 | Weight Kg. |
|------------|----------|-----------|---------|-----|-------|-------|-----------------|----------------|----------------|-------------------|----------------------|---------------------|---------------------|------------------------|------------|
| F3 160M-4  | 11       | 1470      | 400     | 690 | 21,4  | 12,4  | 91,4            | 91,5           | 88,7           | 0,81              | 7,70                 | 2,20                | 2,30                | 0,107                  | 138        |
| F3 160L-4  | 15       | 1470      | 400     | 690 | 29,0  | 16,8  | 92,1            | 92,2           | 89,3           | 0,81              | 7,80                 | 2,20                | 2,30                | 0,129                  | 150        |
| F3 180M-4  | 18,5     | 1470      | 400     | 690 | 35,2  | 20,4  | 92,6            | 92,7           | 89,8           | 0,82              | 7,80                 | 2,00                | 2,30                | 0,190                  | 186        |
| F3 180L-4  | 22       | 1470      | 400     | 690 | 41,6  | 24,1  | 93,0            | 93,1           | 90,2           | 0,82              | 7,80                 | 2,00                | 2,30                | 0,226                  | 206        |
| F3 200L-4  | 30       | 1475      | 400     | 690 | 55,1  | 31,9  | 93,6            | 93,7           | 90,8           | 0,84              | 7,30                 | 2,00                | 2,30                | 0,361                  | 269        |
| F3 225S-4  | 37       | 1480      | 400     | 690 | 66,9  | 38,8  | 93,9            | 94,0           | 91,1           | 0,85              | 7,40                 | 2,00                | 2,30                | 0,630                  | 314        |
| F3 225M-4  | 45       | 1480      | 400     | 690 | 81,1  | 47,0  | 94,2            | 94,3           | 91,4           | 0,85              | 7,40                 | 2,00                | 2,30                | 0,738                  | 356        |
| F3 250M-4  | 55       | 1480      | 400     | 690 | 98,7  | 57,2  | 94,6            | 94,7           | 91,8           | 0,85              | 7,40                 | 2,20                | 2,30                | 1,024                  | 473        |
| F3 280S-4  | 75       | 1490      | 400     | 690 | 134,1 | 77,7  | 95,0            | 95,1           | 92,2           | 0,85              | 6,90                 | 2,00                | 2,30                | 2,083                  | 620        |
| F3 280M-4  | 90       | 1490      | 400     | 690 | 158,7 | 92,0  | 95,4            | 95,5           | 92,5           | 0,86              | 6,90                 | 2,00                | 2,30                | 2,546                  | 673        |
| F3 315S-4  | 110      | 1485      | 400     | 690 | 193,5 | 112,2 | 95,4            | 95,5           | 92,5           | 0,86              | 7,00                 | 2,00                | 2,20                | 3,490                  | 875        |
| F3 315M-4  | 132      | 1485      | 400     | 690 | 229,1 | 132,8 | 95,6            | 95,7           | 92,7           | 0,87              | 7,00                 | 2,00                | 2,20                | 4,014                  | 980        |
| F3 315L-4  | 160      | 1485      | 400     | 690 | 277,1 | 160,6 | 95,8            | 95,9           | 92,9           | 0,87              | 7,10                 | 2,00                | 2,20                | 5,236                  | 1130       |
| F3 315LX-4 | 200      | 1485      | 400     | 690 | 341,7 | 198,1 | 96,0            | 96,1           | 93,1           | 0,88              | 7,10                 | 2,00                | 2,20                | 5,701                  | 1185       |
| F3 355M-4  | 250      | 1490      | 400     | 690 | 422,3 | 244,8 | 96,0            | 96,1           | 93,1           | 0,89              | 7,10                 | 2,00                | 2,20                | 9,297                  | 1660       |
| F3 355LX-4 | 315      | 1490      | 400     | 690 | 532,2 | 308,5 | 96,0            | 96,1           | 93,1           | 0,89              | 7,10                 | 2,00                | 2,20                | 10,286                 | 1850       |
| F3 355LY-4 | 355      | 1490      | 400     | 690 | 599,7 | 347,7 | 96,0            | 96,1           | 93,1           | 0,89              | 7,00                 | 1,70                | 2,20                | 11,275                 | 1865       |

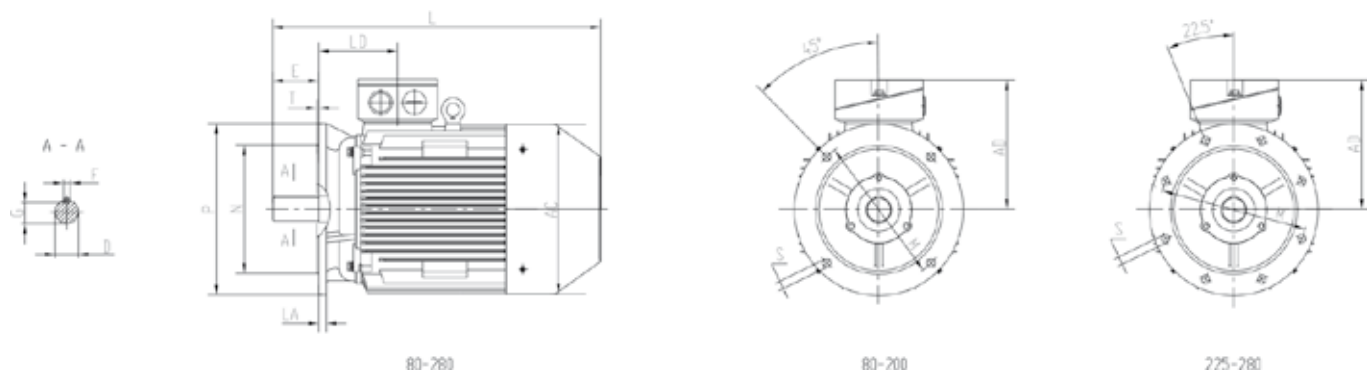
| TYPE       | Power KW | RPM r/min | Voltage |     | Amp   | Amp   | Efficiency 100% | Efficiency 75% | Efficiency 50% | Power Factor cosφ | Locked Current Is/In | Locked Torque Ts/Tn | Locked Torque Tm/Tn | Moment of inertia Kgm2 | Weight Kg. |
|------------|----------|-----------|---------|-----|-------|-------|-----------------|----------------|----------------|-------------------|----------------------|---------------------|---------------------|------------------------|------------|
| F3 160M-6  | 7,5      | 970       | 400     | 690 | 16,6  | 9,6   | 89,1            | 89,2           | 86,4           | 0,73              | 7,00                 | 2,00                | 2,10                | 0,117                  | 122        |
| F3 160L-6  | 11       | 970       | 400     | 690 | 23,8  | 13,8  | 90,3            | 90,4           | 87,6           | 0,74              | 7,20                 | 2,00                | 2,10                | 0,177                  | 144        |
| F3 180L-6  | 15       | 975       | 400     | 690 | 30,1  | 17,4  | 91,2            | 91,3           | 88,5           | 0,79              | 7,30                 | 2,00                | 2,10                | 0,316                  | 201        |
| F3 200L-6  | 18,5     | 980       | 400     | 690 | 36,9  | 21,4  | 91,7            | 91,8           | 88,9           | 0,79              | 7,30                 | 2,00                | 2,10                | 0,468                  | 243        |
| F3 200LX-6 | 22       | 980       | 400     | 690 | 44,2  | 25,6  | 92,2            | 92,3           | 89,4           | 0,78              | 7,40                 | 2,00                | 2,10                | 0,548                  | 259        |
| F3 225M-6  | 30       | 985       | 400     | 690 | 56,8  | 33,0  | 92,9            | 93,0           | 90,1           | 0,82              | 6,90                 | 2,00                | 2,10                | 0,884                  | 333        |
| F3 250M-6  | 37       | 985       | 400     | 690 | 67,7  | 39,3  | 94,1            | 94,2           | 91,3           | 0,84              | 7,10                 | 2,00                | 2,10                | 1,197                  | 404        |
| F3 280S-6  | 45       | 985       | 400     | 690 | 82,5  | 47,8  | 93,7            | 93,8           | 90,9           | 0,84              | 7,30                 | 2,00                | 2,00                | 2,338                  | 586        |
| F3 280M-6  | 55       | 985       | 400     | 690 | 100,4 | 58,2  | 94,1            | 94,2           | 91,3           | 0,84              | 7,30                 | 2,00                | 2,00                | 2,797                  | 665        |
| F3 315S-6  | 75       | 990       | 400     | 690 | 136,2 | 79,0  | 94,6            | 94,7           | 91,8           | 0,84              | 6,60                 | 2,00                | 2,00                | 4,741                  | 860        |
| F3 315M-6  | 90       | 990       | 400     | 690 | 163,0 | 94,5  | 94,9            | 95,0           | 92,1           | 0,84              | 6,70                 | 2,00                | 2,00                | 5,823                  | 980        |
| F3 315L-6  | 110      | 990       | 400     | 690 | 198,8 | 115,2 | 95,1            | 95,2           | 92,2           | 0,84              | 6,70                 | 2,00                | 2,00                | 6,654                  | 1050       |
| F3 315LX-6 | 132      | 985       | 400     | 690 | 235,0 | 136,2 | 95,4            | 95,5           | 92,5           | 0,85              | 6,80                 | 2,00                | 2,00                | 7,985                  | 1100       |
| F3 355M-6  | 160      | 990       | 400     | 690 | 284,2 | 164,8 | 95,6            | 95,7           | 92,7           | 0,85              | 6,80                 | 1,80                | 2,00                | 10,386                 | 1600       |
| F3 355MY-6 | 200      | 990       | 400     | 690 | 354,5 | 205,5 | 95,8            | 95,9           | 92,9           | 0,85              | 6,80                 | 1,80                | 2,00                | 12,413                 | 1720       |
| F3 355LX-6 | 250      | 990       | 400     | 690 | 438,0 | 253,9 | 95,8            | 95,9           | 92,9           | 0,86              | 6,80                 | 1,80                | 2,00                | 13,933                 | 1820       |

## IMB3 - IE3 - CAST IRON



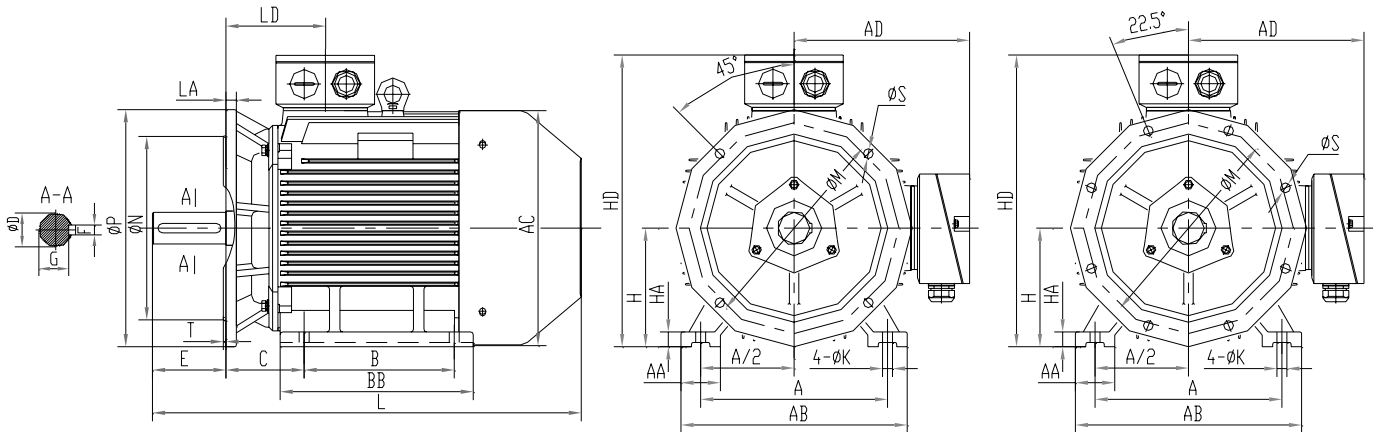
| Frame Size | Pole | Dimensions |     |     |     |     |                      |    | Dimensions |     |     |     |     |    |        |     |      |
|------------|------|------------|-----|-----|-----|-----|----------------------|----|------------|-----|-----|-----|-----|----|--------|-----|------|
|            |      | A          | B   | B1  | B2  | C   | H                    | K  | AA         | AB  | AC  | AD  | BB  | HA | HD     | LD  | L    |
|            |      |            |     |     |     |     |                      |    |            |     |     |     |     |    | on top |     |      |
| 160M/L     | 2-6  | 254        | 210 | 254 | -   | 108 | 160° <sub>-0,5</sub> | 15 | 65         | 315 | 315 | 265 | 305 | 20 | 411    | 146 | 627  |
| 180M       | 2-6  | 279        | 241 | -   | -   | 121 | 180° <sub>-0,5</sub> | 15 | 70         | 350 | 360 | 280 | 315 | 22 | 450    | 161 | 665  |
| 180L       | 4-6  | 279        | 279 | -   | -   | 121 | 180° <sub>-0,5</sub> | 15 | 70         | 350 | 360 | 280 | 350 | 22 | 450    | 161 | 705  |
| 200L       | 2    | 318        | 305 | -   | -   | 133 | 200° <sub>-0,5</sub> | 19 | 70         | 390 | 400 | 310 | 370 | 25 | 500    | 186 | 738  |
| 200L       | 4-6  | 318        | 305 | -   | -   | 133 | 200° <sub>-0,5</sub> | 19 | 70         | 390 | 400 | 310 | 370 | 25 | 500    | 186 | 758  |
| 225S       | 4-6  | 356        | 286 | -   | -   | 149 | 225° <sub>-0,5</sub> | 19 | 75         | 435 | 450 | 335 | 370 | 28 | 555    | 189 | 793  |
| 225M       | 2    | 356        | 311 | -   | -   | 149 | 225° <sub>-0,5</sub> | 19 | 75         | 435 | 450 | 335 | 395 | 28 | 555    | 189 | 775  |
|            | 4-6  | 356        | 311 | -   | -   | 149 | 225° <sub>-0,5</sub> | 19 | 75         | 435 | 450 | 335 | 395 | 28 | 555    | 189 | 818  |
| 250M       | 2    | 406        | 349 | -   | -   | 168 | 250° <sub>-0,5</sub> | 24 | 80         | 485 | 490 | 375 | 445 | 30 | 625    | 207 | 870  |
|            | 4-6  | 406        | 349 | -   | -   | 168 | 250° <sub>-0,5</sub> | 24 | 80         | 485 | 490 | 375 | 445 | 30 | 625    | 207 | 880  |
| 280S       | 2    | 457        | 368 | -   | -   | 190 | 280° <sub>-1,0</sub> | 24 | 85         | 545 | 550 | 405 | 490 | 35 | 670    | 215 | 950  |
|            | 4-6  | 457        | 368 | -   | -   | 190 | 280° <sub>-1,0</sub> | 24 | 85         | 545 | 550 | 405 | 490 | 35 | 670    | 215 | 1020 |
| 280M       | 2    | 457        | 419 | -   | -   | 190 | 280° <sub>-1,0</sub> | 24 | 85         | 545 | 550 | 405 | 540 | 35 | 670    | 215 | 1000 |
|            | 4-6  | 457        | 419 | -   | -   | 190 | 280° <sub>-1,0</sub> | 24 | 85         | 545 | 550 | 405 | 540 | 35 | 670    | 215 | 1070 |
| 315S       | 2    | 508        | 406 | -   | -   | 216 | 315° <sub>-1,0</sub> | 28 | 120        | 630 | 625 | 560 | 570 | 45 | 870    | 257 | 1180 |
|            | 4-6  | 508        | 406 | -   | -   | 216 | 315° <sub>-1,0</sub> | 28 | 120        | 630 | 625 | 560 | 570 | 45 | 870    | 257 | 1185 |
| 315M/L     | 2    | 508        | 457 | 508 | -   | 216 | 315° <sub>-1,0</sub> | 28 | 120        | 630 | 625 | 560 | 680 | 45 | 870    | 257 | 1279 |
|            | 4-6  | 508        | 457 | 508 | -   | 216 | 315° <sub>-1,0</sub> | 28 | 120        | 630 | 625 | 560 | 680 | 45 | 870    | 257 | 1323 |
| 355ML      | 2    | 610        | 500 | 560 | 630 | 254 | 355° <sub>-1,0</sub> | 28 | 120        | 730 | 710 | 615 | 750 | 52 | 956    | 284 | 1526 |
|            | 4-6  | 610        | 500 | 560 | 630 | 254 | 355° <sub>-1,0</sub> | 28 | 120        | 730 | 710 | 615 | 750 | 52 | 956    | 284 | 1556 |

# IMB5 - IE3 - CAST IRON



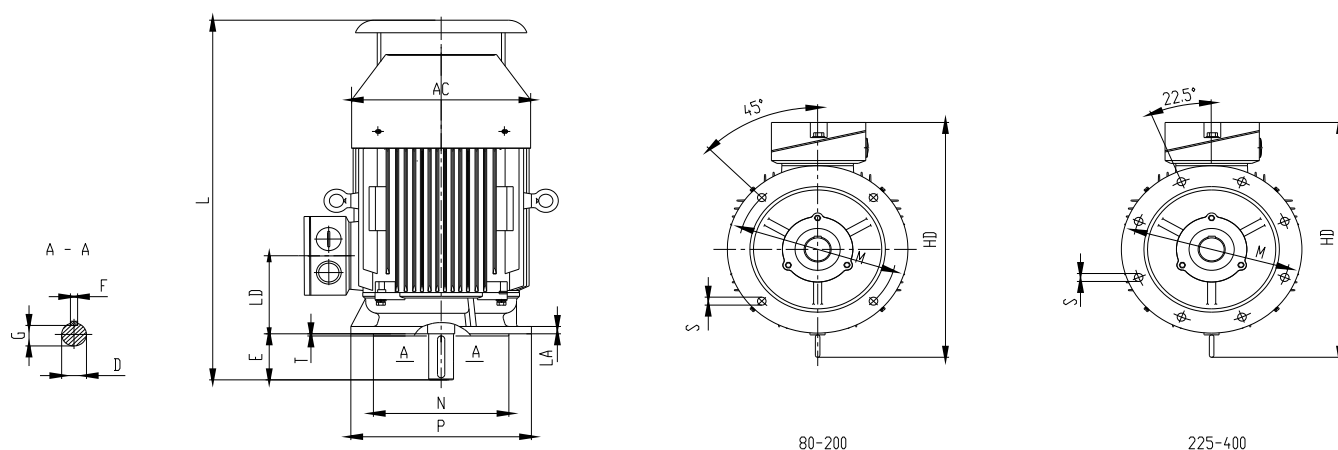
| Frame Size | Pole | Dimensions |     |     |              |   | Dimensions |     |    |     |      |
|------------|------|------------|-----|-----|--------------|---|------------|-----|----|-----|------|
|            |      | M          | N   | P   | S            | T | AC         | AD  | LA | LD  | L    |
| 160M/L     | 2-6  | 300        | 250 | 350 | 4- $\Phi$ 19 | 5 | 315        | 265 | 15 | 146 | 627  |
| 180M       | 2-6  | 300        | 250 | 350 | 4- $\Phi$ 19 | 5 | 360        | 280 | 15 | 161 | 665  |
| 180L       | 4-6  | 300        | 250 | 350 | 4- $\Phi$ 19 | 5 | 360        | 280 | 15 | 161 | 705  |
| 200L       | 2    | 350        | 300 | 400 | 4- $\Phi$ 19 | 5 | 400        | 310 | 17 | 186 | 738  |
| 200L       | 4-6  | 350        | 300 | 400 | 4- $\Phi$ 19 | 5 | 400        | 310 | 17 | 186 | 758  |
| 225S       | 4-6  | 400        | 350 | 450 | 8- $\Phi$ 19 | 5 | 450        | 330 | 20 | 189 | 793  |
| 225M       | 2    | 400        | 350 | 450 | 8- $\Phi$ 19 | 5 | 450        | 330 | 20 | 189 | 775  |
|            | 4-6  | 400        | 350 | 450 | 8- $\Phi$ 19 | 5 | 450        | 330 | 20 | 189 | 818  |
| 250M       | 2    | 500        | 450 | 550 | 8- $\Phi$ 19 | 5 | 490        | 375 | 22 | 207 | 870  |
|            | 4-6  | 500        | 450 | 550 | 8- $\Phi$ 19 | 5 | 490        | 375 | 22 | 207 | 880  |
| 280S       | 2    | 500        | 450 | 550 | 8- $\Phi$ 19 | 5 | 550        | 405 | 22 | 215 | 950  |
|            | 4-6  | 500        | 450 | 550 | 8- $\Phi$ 19 | 5 | 550        | 405 | 22 | 215 | 1020 |
| 280M       | 2    | 500        | 450 | 550 | 8- $\Phi$ 19 | 5 | 550        | 405 | 22 | 215 | 1000 |
|            | 4-6  | 500        | 450 | 550 | 8- $\Phi$ 19 | 5 | 550        | 405 | 22 | 215 | 1070 |

# IMB3/B5 - IE3 - CAST IRON



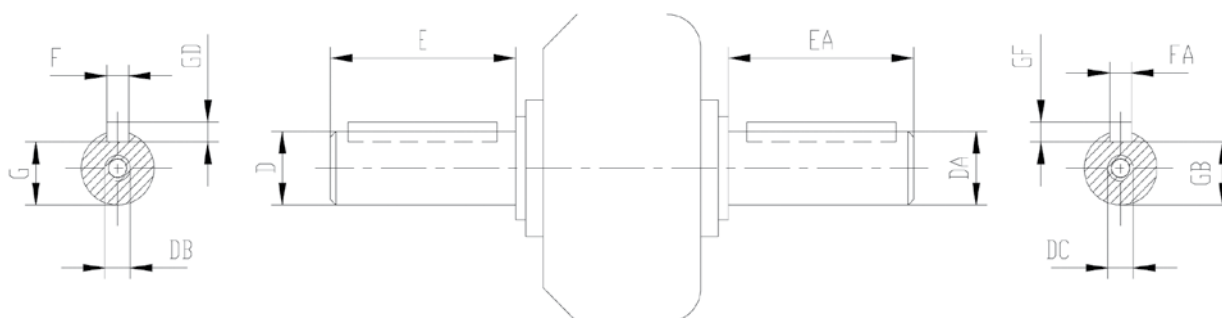
| Frame Size | Pole | Dimensions |     |     |     |     |                      |    |     |     |     |       |   |     | Dimensions |     |     |     |    |     |     |     |    |     |      |  |  |
|------------|------|------------|-----|-----|-----|-----|----------------------|----|-----|-----|-----|-------|---|-----|------------|-----|-----|-----|----|-----|-----|-----|----|-----|------|--|--|
|            |      | A          | B   | B1  | B2  | C   | H                    | K  | M   | N   | P   | S     | T | AA  | AB         | AC  | AD  | BB  | HA | HB  | HD  |     | LA | LD  | L    |  |  |
|            |      |            |     |     |     |     |                      |    |     |     |     |       |   |     |            |     |     |     |    |     | Top | L&R |    |     |      |  |  |
| 160M/L     | 2-6  | 254        | 210 | 254 |     | 108 | 160° <sub>-0,5</sub> | 15 | 300 | 250 | 350 | 4-Φ19 | 5 | 65  | 315        | 315 | 265 | 305 | 20 | 81  | 411 | 385 | 15 | 146 | 627  |  |  |
| 180M       | 2-6  | 279        | 241 | -   |     | 121 | 180° <sub>-0,5</sub> | 15 | 300 | 250 | 350 | 4-Φ19 | 5 | 70  | 350        | 360 | 280 | 315 | 22 | 105 | 450 | 420 | 15 | 161 | 665  |  |  |
| 180L       | 4-6  | 279        | 279 | -   |     | 121 | 180° <sub>-0,5</sub> | 15 | 300 | 250 | 350 | 4-Φ19 | 5 | 70  | 350        | 360 | 280 | 350 | 22 | 105 | 450 | 420 | 15 | 161 | 705  |  |  |
| 200L       | 2    | 318        | 305 | -   |     | 133 | 200° <sub>-0,5</sub> | 19 | 350 | 300 | 400 | 4-Φ19 | 5 | 70  | 390        | 400 | 310 | 370 | 25 | 85  | 500 | 475 | 17 | 186 | 738  |  |  |
| 200L       | 4-6  | 318        | 305 | -   |     | 133 | 200° <sub>-0,5</sub> | 19 | 350 | 300 | 400 | 4-Φ19 | 5 | 70  | 390        | 400 | 310 | 370 | 25 | 85  | 500 | 475 | 17 | 186 | 758  |  |  |
| 225S       | 4-6  | 356        | 286 | -   |     | 149 | 225° <sub>-0,5</sub> | 19 | 400 | 350 | 450 | 8-Φ19 | 5 | 75  | 435        | 450 | 335 | 370 | 28 | 110 | 555 | 535 | 20 | 189 | 793  |  |  |
| 225M       | 2    | 356        | 311 | -   |     | 149 | 225° <sub>-0,5</sub> | 19 | 400 | 350 | 450 | 8-Φ19 | 5 | 75  | 435        | 450 | 335 | 395 | 28 | 110 | 555 | 535 | 20 | 189 | 775  |  |  |
|            | 4-6  | 356        | 311 | -   |     | 149 | 225° <sub>-0,5</sub> | 19 | 400 | 350 | 450 | 8-Φ19 | 5 | 75  | 435        | 450 | 335 | 395 | 28 | 110 | 555 | 535 | 20 | 189 | 818  |  |  |
| 250M       | 2    | 406        | 349 | -   |     | 168 | 250° <sub>-0,5</sub> | 24 | 500 | 450 | 550 | 8-Φ19 | 5 | 80  | 485        | 490 | 375 | 445 | 30 | 110 | 625 | 570 | 22 | 207 | 870  |  |  |
|            | 4-6  | 406        | 349 | -   |     | 168 | 250° <sub>-0,5</sub> | 24 | 500 | 450 | 550 | 8-Φ19 | 5 | 80  | 485        | 490 | 375 | 445 | 30 | 120 | 625 | 570 | 22 | 207 | 880  |  |  |
| 280S       | 2    | 457        | 368 | -   |     | 190 | 280° <sub>-1,0</sub> | 24 | 500 | 450 | 550 | 8-Φ19 | 5 | 85  | 545        | 550 | 405 | 490 | 35 | 142 | 670 | 660 | 22 | 215 | 950  |  |  |
|            | 4-6  | 457        | 368 | -   |     | 190 | 280° <sub>-1,0</sub> | 24 | 500 | 450 | 550 | 8-Φ19 | 5 | 85  | 545        | 550 | 405 | 490 | 35 | 142 | 670 | 660 | 22 | 215 | 1020 |  |  |
| 280M       | 2    | 457        | 419 | -   |     | 190 | 280° <sub>-1,0</sub> | 24 | 500 | 450 | 550 | 8-Φ19 | 5 | 85  | 545        | 550 | 405 | 540 | 35 | 142 | 670 | 660 | 22 | 215 | 1000 |  |  |
|            | 4-6  | 457        | 419 | -   |     | 190 | 280° <sub>-1,0</sub> | 24 | 500 | 450 | 550 | 8-Φ19 | 5 | 85  | 545        | 550 | 405 | 540 | 35 | 142 | 670 | 660 | 22 | 215 | 1070 |  |  |
| 315S       | 2    | 508        | 406 | -   |     | 216 | 315° <sub>-1,0</sub> | 28 | 600 | 550 | 660 | 8-Φ24 | 6 | 120 | 630        | 625 | 530 | 570 | 45 | 110 | 870 | 750 | 22 | 257 | 1108 |  |  |
|            | 4-6  | 508        | 406 | -   |     | 216 | 315° <sub>-1,0</sub> | 28 | 600 | 550 | 660 | 8-Φ24 | 6 | 120 | 630        | 625 | 530 | 570 | 45 | 110 | 870 | 750 | 22 | 257 | 1185 |  |  |
| 315M/L     | 2    | 508        | 457 | 508 |     | 216 | 315° <sub>-1,0</sub> | 28 | 600 | 550 | 660 | 8-Φ24 | 6 | 120 | 630        | 625 | 530 | 680 | 45 | 110 | 870 | 750 | 22 | 257 | 1279 |  |  |
|            | 4-6  | 508        | 457 | 508 |     | 216 | 315° <sub>-1,0</sub> | 28 | 600 | 550 | 660 | 8-Φ24 | 6 | 120 | 630        | 625 | 530 | 680 | 45 | 110 | 870 | 750 | 22 | 257 | 1323 |  |  |
| 355ML      | 2    | 610        | 500 | 560 | 630 | 254 | 355° <sub>-1,0</sub> | 28 | 740 | 680 | 800 | 8-Φ24 | 6 | 120 | 730        | 710 | 615 | 750 | 52 | 125 | 956 | 830 | 25 | 284 | 1526 |  |  |
|            | 4-6  | 610        | 500 | 560 | 630 | 254 | 355° <sub>-1,0</sub> | 28 | 740 | 680 | 800 | 8-Φ24 | 6 | 120 | 730        | 710 | 615 | 750 | 52 | 125 | 956 | 830 | 25 | 284 | 1556 |  |  |

# IMV1 - IE3 - CAST IRON



| Frame Size | Pole | Dimensions |     |     |              | Dimensions |     |      |    |     |      |
|------------|------|------------|-----|-----|--------------|------------|-----|------|----|-----|------|
|            |      | M          | N   | P   | S            | T          | AC  | HD   | LA | LD  | L    |
| 160M/L     | 2-6  | 300        | 250 | 350 | 4- $\Phi$ 19 | 5          | 315 | 476  | 15 | 146 | 680  |
| 180M       | 2-6  | 300        | 250 | 350 | 4- $\Phi$ 19 | 5          | 360 | 510  | 15 | 161 | 710  |
| 180L       | 4-6  | 300        | 250 | 350 | 4- $\Phi$ 19 | 5          | 360 | 510  | 15 | 161 | 770  |
| 200L       | 2    | 350        | 300 | 400 | 4- $\Phi$ 19 | 5          | 400 | 565  | 17 | 186 | 818  |
| 200L       | 4-6  | 350        | 300 | 400 | 4- $\Phi$ 19 | 5          | 400 | 565  | 17 | 186 | 838  |
| 225S       | 4-6  | 400        | 350 | 450 | 8- $\Phi$ 19 | 5          | 450 | 620  | 20 | 189 | 887  |
| 225M       | 2    | 400        | 350 | 450 | 8- $\Phi$ 19 | 5          | 450 | 620  | 20 | 189 | 873  |
|            | 4-6  | 400        | 350 | 450 | 8- $\Phi$ 19 | 5          | 450 | 620  | 20 | 189 | 942  |
| 250M       | 2    | 500        | 450 | 550 | 8- $\Phi$ 19 | 5          | 490 | 695  | 22 | 207 | 971  |
|            | 4-6  | 500        | 450 | 550 | 8- $\Phi$ 19 | 5          | 490 | 695  | 22 | 207 | 1005 |
| 280S       | 2    | 500        | 450 | 550 | 8- $\Phi$ 19 | 5          | 550 | 755  | 22 | 215 | 1071 |
|            | 4-6  | 500        | 450 | 550 | 8- $\Phi$ 19 | 5          | 550 | 755  | 22 | 215 | 1138 |
| 280M       | 2    | 500        | 450 | 550 | 8- $\Phi$ 19 | 5          | 550 | 755  | 22 | 215 | 1116 |
|            | 4-6  | 500        | 450 | 550 | 8- $\Phi$ 19 | 5          | 550 | 755  | 22 | 215 | 1193 |
| 315S       | 2    | 600        | 550 | 660 | 8- $\Phi$ 24 | 6          | 625 | 985  | 22 | 257 | 1329 |
|            | 4-6  | 600        | 550 | 660 | 8- $\Phi$ 24 | 6          | 625 | 985  | 22 | 257 | 1345 |
| 315M/L     | 2    | 600        | 550 | 660 | 8- $\Phi$ 24 | 6          | 625 | 985  | 22 | 257 | 1453 |
|            | 4-6  | 600        | 550 | 660 | 8- $\Phi$ 24 | 6          | 625 | 985  | 22 | 257 | 1483 |
| 355ML      | 2    | 740        | 680 | 800 | 8- $\Phi$ 24 | 6          | 710 | 1001 | 25 | 284 | 1665 |
|            | 4-6  | 740        | 680 | 800 | 8- $\Phi$ 24 | 6          | 710 | 1001 | 25 | 284 | 1700 |

## DIMENSIONE ALBERO - SHAFT DIMENSION



| Frame | Pole  | D     | *DA   | E   | *EA   | F   | *FA | G    | *GB  | GD | *GF | DB-DC  |        |
|-------|-------|-------|-------|-----|-------|-----|-----|------|------|----|-----|--------|--------|
| 160M  | 2-4-6 | 42 k6 | 42 k6 | 110 | 110   | 12  | 12  | 37   | 37   |    |     | M16x36 |        |
| 160L  |       |       |       |     |       |     |     |      |      |    |     |        |        |
| 180M  | 2-4-6 | 48 k6 | 48 k6 |     |       | 14  | 14  | 42,5 | 42,5 | 9  | 9   |        |        |
| 180L  |       |       |       |     |       |     |     |      |      |    |     |        |        |
| 200L  | 2-4-6 | 55 m6 | 55 m6 |     |       | 140 | 16  | 16   | 49   | 49 | 10  | 10     | M20x42 |
| 225S  | 4-6   | 60 m6 | 55 m6 | 140 |       |     | 18  | 16   | 53   | 49 | 11  | 10     |        |
| 225M  | 2     | 55 m6 | 48 k6 | 110 |       | 16  | 14  | 49   | 45,5 | 10 | 9   |        |        |
|       | 4-6   | 60 m6 | 55 m6 | 140 |       |     |     |      |      |    |     | 18     |        |
| 250M  | 2     | 60 m6 |       |     |       | 53  | 49  | 11   | 10   |    |     |        |        |
|       | 4-6   | 65 m6 |       |     |       | 58  | 49  |      |      |    |     |        |        |
| 280S  | 2     | 65 m6 |       |     | 65 m6 | 110 | 58  | 49   | 11   | 10 |     |        |        |
|       | 4-6   | 75 m6 | 140   | 20  |       |     |     |      |      |    | 18  | 67,5   |        |
| 280M  | 2     | 65 m6 | 55 m6 | 110 | 18    | 16  | 58  | 49   | 11   | 10 |     |        |        |
|       | 4-6   | 75 m6 | 65 m6 |     |       |     |     |      |      |    | 140 | 20     |        |
| 315S  | 2     | 65 m6 | 65 m6 | 140 | 140   | 18  | 18  | 58   | 58   | 11 | 11  | M24x50 |        |
|       | 4-6   | 80 m6 | 80 m6 | 170 | 170   | 22  | 22  | 71   | 71   | 14 | 14  |        |        |
| 315ML | 2     | 65 m6 | 65 m6 | 140 | 140   | 18  | 18  | 58   | 58   | 11 | 11  |        |        |
|       | 4-6   | 80 m6 | 80 m6 | 170 | 170   | 22  | 22  | 71   | 71   | 14 | 14  |        |        |
| 355ML | 2     | 75 m6 | 75 m6 | 140 | 140   | 20  | 20  | 67,5 | 67,5 | 12 | 12  | M24x50 |        |
|       | 4-6   | 100m6 | 100m6 | 210 | 210   | 28  | 28  | 90   | 90   | 14 | 14  |        |        |

\*Dimensions for NDE shaft, when it's requested, shall be confirmed with order agreement.

# BEARINGS

| Frame            | D.E.        | D.E.        | D.E.        | N.D.E.      | N.D.E.      | N.D.E.      |
|------------------|-------------|-------------|-------------|-------------|-------------|-------------|
|                  | 2 pole      | 4 pole      | 6 pole      | 2 pole      | 4 pole      | 6 pole      |
| <b>Aluminium</b> |             |             |             |             |             |             |
| FA3 80           | 6204 2RS C3 | 6204 2RS C3 | 6204 2RS C3 | 6204 2RS C3 | 6204 2RS C3 | 6204 2RS C3 |
| FA3 90           | 6205 2RS C3 | 6205 2RS C3 | 6205 2RS C3 | 6205 2RS C3 | 6205 2RS C3 | 6205 2RS C3 |
| FA3 100          | 6206 2RS C3 | 6206 2RS C3 | 6206 2RS C3 | 6206 2RS C3 | 6206 2RS C3 | 6206 2RS C3 |
| FA3 112          | 6306 2RS C3 | 6306 2RS C3 | 6306 2RS C3 | 6206 2RS C3 | 6206 2RS C3 | 6206 2RS C3 |
| FA3 132          | 6308 2RS C3 | 6308 2RS C3 | 6308 2RS C3 | 6208 2RS C3 | 6208 2RS C3 | 6208 2RS C3 |

|                  |            |            |            |            |            |            |
|------------------|------------|------------|------------|------------|------------|------------|
| <b>Cast Iron</b> |            |            |            |            |            |            |
| F3 160           | 6309 ZZ C3 | 6309 ZZ C3 | 6309 ZZ C3 | 6309 ZZ C3 | 6309 ZZ C3 | 6309 ZZ C3 |
| F3 180           | 6311 ZZ C3 | 6311 ZZ C3 | 6311 ZZ C3 | 6311 ZZ C3 | 6311 ZZ C3 | 6311 ZZ C3 |
| F3 200           | 6312 ZZ C3 | 6312 ZZ C3 | 6312 ZZ C3 | 6312 ZZ C3 | 6312 ZZ C3 | 6312 ZZ C3 |
| F3 225           | 6313 ZZ C3 | 6313 ZZ C3 | 6313 ZZ C3 | 6313 ZZ C3 | 6313 ZZ C3 | 6313 ZZ C3 |
| F3 250           | 6314 C3    | 6314 C3    | 6314 C3    | 6314 C3    | 6314 C3    | 6314 C3    |
| F3 280           | 6314 C3    | 6317 C3    | 6317 C3    | 6314 C3    | 6317 C3    | 6317 C3    |
| F3 315           | 6317 C3    | 6319 C3    | 6319 C3    | 6317 C3    | 6319 C3    | 6319 C3    |
| F3 355           | 6317 C3    | 6322 C3    | 6322 C3    | 6317 C3    | 6320 C3    | 6320 C3    |
| F3 355           | 6317 C3    | 6322 C3    | 6322 C3    | 6317 C3    | 6320 C3    | 6320 C3    |

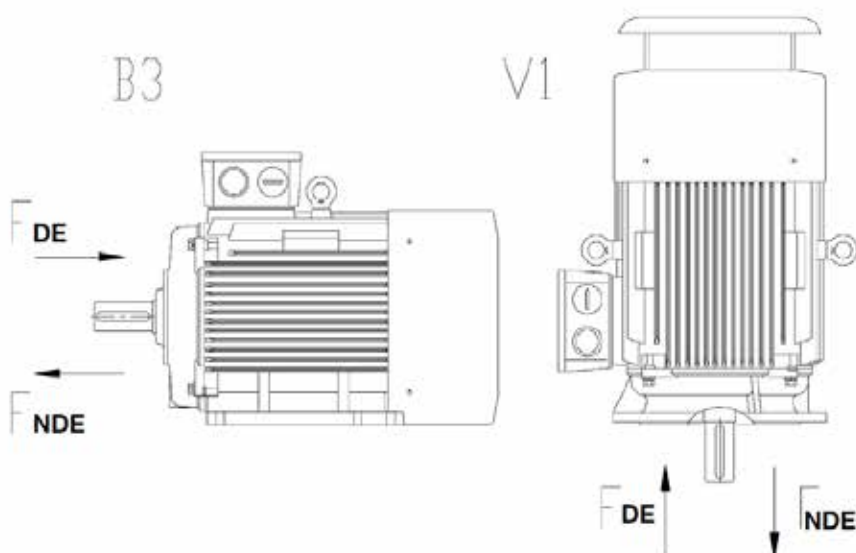
# CABLE GLANDS

| <b>Aluminium</b> | <b>Ø Thread</b> | <b>Exit hole (mm)</b> |
|------------------|-----------------|-----------------------|
| FA3 80           | M25x1,5         | 11...17               |
| FA3 90           | M25x1,5         | 11...17               |
| FA3 100          | M25x1,5         | 11...17               |
| FA3 112          | M25x1,5         | 11...17               |
| FA3 132          | M25x1,5         | 11...17               |
| FA3 160          | M40x1,5         | 19...28               |
| <b>Cast Iron</b> |                 |                       |
| F3 160           | M40x1,5         | 19...28               |
| F3 180           | M40x1,5         | 19...28               |
| F3 200           | M50x1,5         | 26...35               |
| F3 225           | M50x1,5         | 26...35               |
| F3 250           | M63x1,5         | 32...48               |
| F3 280           | M63x1,5         | 32...48               |
| F3 315           | M63x1,5         | 32...48               |
| F3 355           | M72x2           | ///                   |

All data listed in the tables are indicative and not binding. The guaranteed values are upon request. Felm srl reserves the right to change the project, the technical characteristics and dimensions at any time without previous notice.

# PERMISSIBLE AXIAL LOADS

The following table gives the permissible axial forces in Newton, assuming zero radial force. In this case motor should be ordered with standard ball bearings. In case of higher axial force than given in the table an angular contact bearing should be ordered. The values are based on normal conditions at 50Hz. and calculated at 20000 working hour for two pole motors and 40000 hours for 4, 6 and 8 pole motors. At 60Hz. the values must be reduced by 10%. For two-speed motors the values have to be based at the higher speed. Fpressure (D.E.) is calculated for a fixed bearing at the Drive End.



| Frame Size | pole | Maximum axial force (FA) |         |        |         |
|------------|------|--------------------------|---------|--------|---------|
|            |      | B3 FDE                   | B3 FNDE | V1 FDE | V1 FNDE |
| 80         | 2    | 380                      | 380     | 400    | 360     |
|            | 4    | 470                      | 470     | 490    | 450     |
|            | 6    | 590                      | 590     | 620    | 560     |
|            | 8    | 620                      | 620     | 650    | 595     |
| 90         | 2    | 440                      | 440     | 470    | 410     |
|            | 4    | 550                      | 550     | 600    | 510     |
|            | 6    | 620                      | 620     | 680    | 460     |
|            | 8    | 640                      | 640     | 700    | 580     |
| 100        | 2    | 610                      | 610     | 670    | 570     |
|            | 4    | 750                      | 750     | 840    | 710     |
|            | 6    | 880                      | 88      | 0970   | 820     |
|            | 8    | 895                      | 895     | 970    | 845     |
| 112        | 2    | 1220                     | 1220    | 1300   | 1170    |
|            | 4    | 1440                     | 1440    | 1520   | 1370    |
|            | 6    | 1650                     | 1650    | 1740   | 1580    |
|            | 8    | 1780                     | 1780    | 1880   | 1710    |
| 132        | 2    | 1500                     | 1500    | 1620   | 1430    |
|            | 4    | 1780                     | 1780    | 1970   | 1610    |
|            | 6    | 1820                     | 1820    | 2000   | 1660    |
|            | 8    | 1920                     | 1920    | 2100   | 1760    |
| 160        | 2    | 1650                     | 1650    | 1950   | 1350    |
|            | 4    | 2100                     | 2100    | 2470   | 1720    |
|            | 6    | 2450                     | 2450    | 2800   | 2050    |
|            | 8    | 2650                     | 2650    | 3050   | 2210    |
| 180        | 2    | 2100                     | 2100    | 2450   | 1720    |
|            | 4    | 2600                     | 2600    | 3200   | 2000    |
|            | 6    | 2900                     | 2900    | 3510   | 2280    |
|            | 8    | 3170                     | 3170    | 3780   | 2550    |

| Frame Size | pole | Maximum axial force (FA) |         |        |         |
|------------|------|--------------------------|---------|--------|---------|
|            |      | B3 FDE                   | B3 FNDE | V1 FDE | V1 FNDE |
| 200        | 2    | 2400                     | 2400    | 2940   | 1840    |
|            | 4    | 3120                     | 3120    | 3850   | 2390    |
|            | 6    | 3480                     | 3480    | 4350   | 2610    |
|            | 8    | 3950                     | 3950    | 4810   | 3090    |
| 225        | 2    | 2720                     | 2720    | 3420   | 2020    |
|            | 4    | 2480                     | 3480    | 4370   | 2590    |
|            | 6    | 2890                     | 3890    | 5040   | 2820    |
|            | 8    | 4330                     | 4330    | 5330   | 3330    |
| 250        | 2    | 3100                     | 3100    | 3940   | 2260    |
|            | 4    | 3900                     | 3900    | 5000   | 2800    |
|            | 6    | 4450                     | 4450    | 5570   | 3230    |
|            | 8    | 4980                     | 4980    | 6380   | 3580    |
| 280        | 2    | 5300                     | 3100    | 6500   | 2100    |
|            | 4    | 6300                     | 4400    | 7800   | 3000    |
|            | 6    | 6700                     | 4300    | 7900   | 2900    |
|            | 8    | 7100                     | 5020    | 9100   | 3520    |
| 315        | 2    | 5900                     | 3800    | 8000   | 2000    |
|            | 4    | 7100                     | 5100    | 10700  | 3150    |
|            | 6    | 7600                     | 5800    | 11800  | 3500    |
|            | 8    | 8100                     | 6300    | 12500  | 4400    |
| 355*       | 2    | 6100                     | 1850    | 14000  | 800     |
|            | 4    | 9800                     | 3900    | 18300  | 2500*   |
|            | 6    | 10500                    | 4700    | 20700  | 3500*   |
|            | 8    | 12500                    | 6000    | 21500  | 3600*   |

\*= Data calculated with roll bearings

# PERMISSIBLE RADIAL LOADS

The following table give the permissible radial forces in Newton, assuming zero axial force and standard ball bearings. In case of higher radial force than give in the table an enforced bearing should be ordered. The values are based on normal conditions at 50 Hz and calculated at 20 000 working hours for the two pole motors and 40 000 working hours for 4,6 and 8 poles. For 60 Hz the value must be reduced by 10%. For two speed motors, the values have to be based at the higher speed.

## Pulley diameter:

when the desired bearing life has been determined, the minimum pulley diameter can be calculated with the following formula:

$$D_{min} = \frac{1.9 \times 10^7 \times k \times P_N}{n_N \times F_R}$$

$D_{min}$  = diameter of the pulley (mm)

$P$  = power of the motor (kW)

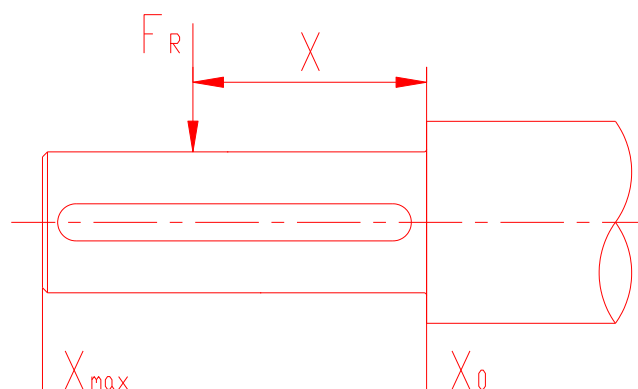
$n$  = motor rated speed (r/min)

$K$  = belt tension factor,  $k=2.5$  for V-belt

$F_{R(X)}$  = permissible radial force (N)

$$F_R = F_{X0} - \frac{X}{E} (F_{X0} - F_{Xmax})$$

$E$  = the length of the shaft diameter (mm.) in basic version



| Frame Size | pole | Maximum radial force (FA) |           |           |
|------------|------|---------------------------|-----------|-----------|
|            |      | $X_0$                     | $X_{1/2}$ | $X_{max}$ |
| 80         | 2    | 670                       | 610       | 550       |
|            | 4    | 730                       | 650       | 590       |
|            | 6    | 830                       | 750       | 680       |
|            | 8    | 920                       | 820       | 750       |
| 90         | 2    | 740                       | 660       | 590       |
|            | 4    | 800                       | 710       | 630       |
|            | 6    | 920                       | 810       | 730       |
|            | 8    | 1010                      | 890       | 800       |
| 100        | 2    | 1030                      | 920       | 820       |
|            | 4    | 1110                      | 990       | 890       |
|            | 6    | 1270                      | 1130      | 1020      |
|            | 8    | 1400                      | 1240      | 1120      |
| 112        | 2    | 1490                      | 1330      | 1200      |
|            | 4    | 1600                      | 1430      | 1290      |
|            | 6    | 1840                      | 1640      | 1480      |
|            | 8    | 2020                      | 1800      | 1630      |
| 132        | 2    | 2160                      | 1900      | 1690      |
|            | 4    | 2330                      | 2040      | 1820      |
|            | 6    | 2670                      | 2340      | 2080      |
|            | 8    | 2940                      | 2570      | 2290      |
| 160        | 2    | 2800                      | 2440      | 2170      |
|            | 4    | 3000                      | 2630      | 2330      |
|            | 6    | 3440                      | 3010      | 2670      |
|            | 8    | 3850                      | 3410      | 3060      |
| 180        | 2    | 3930                      | 3500      | 3150      |
|            | 4    | 4240                      | 3770      | 3390      |
|            | 6    | 4890                      | 4390      | 3980      |
|            | 8    | 5380                      | 4830      | 4380      |

| Frame Size | pole | Maximum radial force (FA) |           |           |
|------------|------|---------------------------|-----------|-----------|
|            |      | $X_0$                     | $X_{1/2}$ | $X_{max}$ |
| 200        | 2    | 4480                      | 4050      | 3700      |
|            | 4    | 4820                      | 4360      | 3980      |
|            | 6    | 5520                      | 5000      | 4560      |
|            | 8    | 6080                      | 5500      | 5020      |
| 225        | 2    | 5000                      | 4540      | 4160      |
|            | 4    | 5360                      | 4720      | 4210      |
|            | 6    | 6180                      | 5480      | 4920      |
|            | 8    | 6750                      | 5940      | 5310      |
| 250        | 2    | 5680                      | 5100      | 4620      |
|            | 4    | 6120                      | 5490      | 4980      |
|            | 6    | 7000                      | 6280      | 5700      |
|            | 8    | 7710                      | 6920      | 6270      |
| 280        | 2    | 5620                      | 5080      | 4640      |
|            | 4    | 7790                      | 7050      | 6430      |
|            | 6    | 8920                      | 8060      | 7360      |
|            | 8    | 9820                      | 8880      | 8100      |
| 315        | 2    | 7370                      | 6840      | 6390      |
|            | 4    | 9150                      | 8370      | 7720      |
|            | 6    | 10480                     | 9590      | 8830      |
|            | 8    | 11530                     | 10550     | 9720      |
| 355*       | 2    | 16330                     | 15390     | 8730      |
|            | 4    | 28300                     | 25860     | 14290     |
|            | 6    | 32400                     | 29600     | 16350     |
|            | 8    | 35660                     | 32580     | 18000     |





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