DETERMINING OF FUNCTIONAL PARAMETERS IN ELECTRICAL DRIVES ACCORDING MOUNTING ARRANGEMENTS

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Abstract. *The electric motors are part of any electric drive. Depending on the way of connecting the electric motor and executive mechanism, the electric motor must be have specified mounting arrangements. The mounting arrangements of the electric motors are regulated by BDS EN 60034-7:2007. Rotating electrical machines – Part 7: Classification of types of construction, mounting arrangements and terminal box position (IM Code). On the mounting arrangements of the electric motors determine its functional parameters. They are quality indicators of each assembled unit. Functional dimensioning of the electric motors connected to the correct operation of the system "electric drive". This paper recommends this approach be offered to Students – Bachelor in teaching them discipline Fundamentals of Engineering Design.*

Keywords: *electric drive, electric motor, functional dimensioning*

1. INTRODUCTION

Electric drive is system which consists of a power supply, an electric motor and reducer. This system is designed as to move actuator by electricity. Electric drives are used primarily in industry, electric transport, households. In Fig. 1 shows the scheme of electric drive.

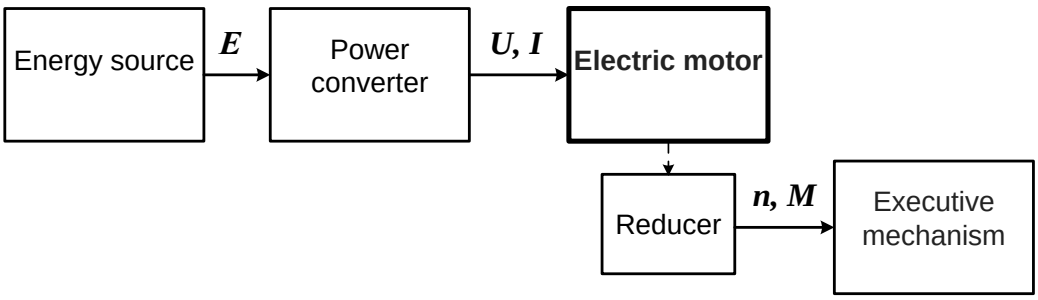


Fig. 1

The source of the energy lodged single phase or three-phase sinusoidal voltage with fixed frequency and amplitude. Power converter converts electrical energy ***E*** in the proper format (frequency, voltage ***U*** and current ***I***) with values that are optimal for the operation of the electric motor. The electric motor is an electromechanical device that converts electrical energy to mechanical energy that drives the working machine. The electric motor consists of a stator – a stationary component and a rotor –

rolling component. In the stator creates a rotating magnetic field which is necessary to drive the rotor. The rotor rotates on a shaft that is connected to the housing through bearings. The working machine to be operated is connected to the shaft.

The working position of the actuator depends on how it will be connected to the electric motor. Of this relationship depends on what will be the operating state of the electric motor. Mounting arrangements electric motors are regulated by BDS EN 60034-7 [1].

Proper functioning of a system largely depends on the performance of precision requirements for its components [2, 3]. Determining the installation parameters representing these precision requirements called functional dimensioning of the assembled units. The functional dimensioning of the electric motor is related to its working position and then to its mounting arrangements.

2. CLASSIFICATION OF MOUNTING ARRANGEMENTS OF ELECTRIC MOTORS

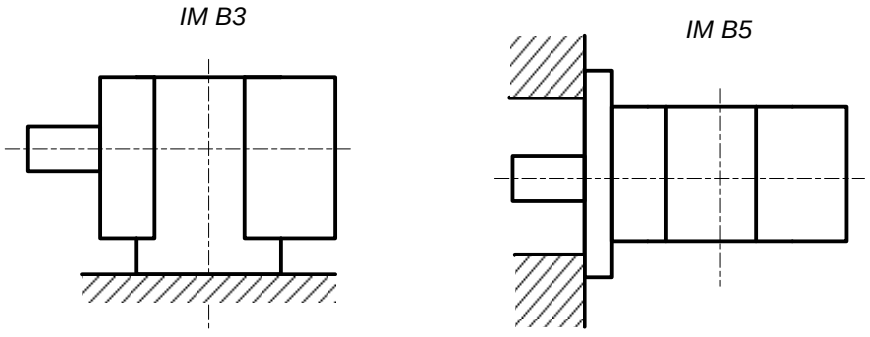
The mounting arrangements of electric motors are regulated by BS EN 60034-7: 2007 Rotating electrical machines. Part 7: Classification of types of construction, mounting arrangements and terminal box position (IM code). The standard gives two classification systems:

- an alpha – numeric designation applicable to machines with end shield bearings and only one shaft extension (code I);
- an all numerical designation applicable to a wider range of types of machines (code II), including types covered by code I.

2.1. Code I – alpha–numeric designation

- *Designation machines with horizontal shaft*

In the *Code I* machine with a horizontal shaft is designated by alpha code **IM** (international mounting), followed by a space, letter **B** and one or two digits – **IM Bxx** (Fig. 2).



a b

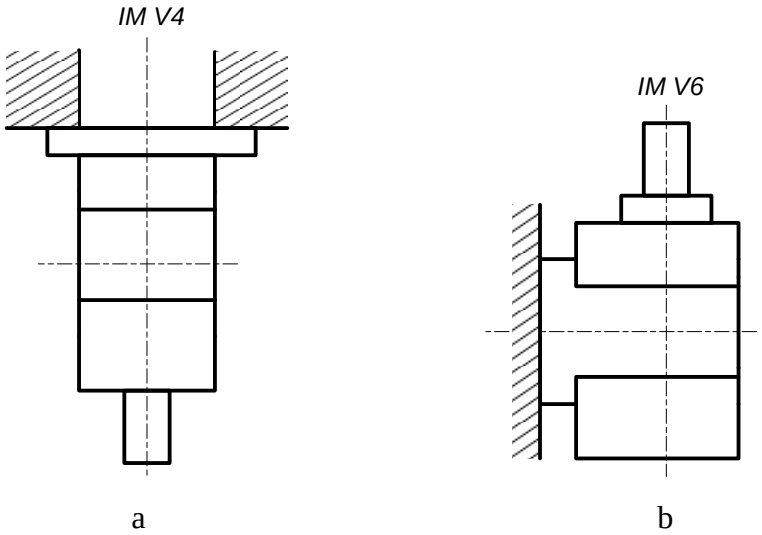
Fig. 2

Digits in the designation indicate the type of electrical machine design – bearings shields presence of foot, flange presence, presence of additional details. Designation

IM B3 (Fig. 2 a) is an electric machine with a horizontal shaft (letter **B**), two bearings shields, with feet (feet down) (the digit **3**). Designation **IM B5** (Fig. 2 b) electrical machine with a horizontal shaft (letter **B**), two bearings shields, no feet, flange, additional detail – flange shield D – end (drive end of the machine) with rear access, mounted on the flange side of the D – end (the digit **5**).

- *Designation machines with vertical shaft*

In the *Code I* machine vertical shaft is indicated by alpha code **IM** (international mounting), followed by a space, letter **V** and one or two digits - **IM Vxx** (Fig. 3).



a b

Fig. 3

2.2. Code II - numerical designation

In *Code II* a machine is indicated by a letter code **IM** (international mounting), followed by a space and four digits – **IM xxxx**. The first, second and third digits indicate the embodiment of the machine. The first digit defines the installation of the machine (the presence of foot, bearing shields, flanges, additional bearing supports). The significance of the second and third digits is determined by the first digit to which they are connected. Fourth digit indicates the type of shaft end (cylindrical – 1, 2, cone – 3, 4, flange – 5, 6, 7; not determined – 8, other ways – 9). If after four numbers used point, it should mean the location of the terminal box.

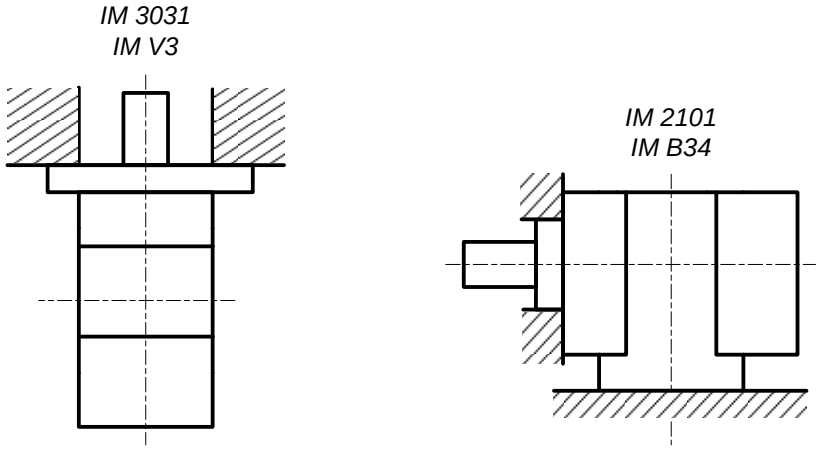
2.3. Relationship between Code I and Code II

Since the designation *Code II* has a wider range including machines covered by the *Code I*, there is a connection between the *Code I* and *Code II* (Table 1).

In Fig. 4a shows an example of the relationship between the code I and the code II. The electric machine is according *Code I* designation **IM V3**, and according to *Code II* designation **IM 3031** (Fig. 4a). In Fig. 4b electric machine *code I* have under designation **IM B34**, and according to *Code II* designation **IM 2101**.

Table 1

machines with horizontal shaft		machines with vertical shaft	
Code I	***Code II***	***Code I***	***Code II***
IM B3	IM 1001	IM V1	IM 3011
IM B5	IM 3001	IM V2	IM 3231
IM B6	IM 1051	IM V3	IM 3031
IM B7	IM 1061	IM V4	IM 3231
IM B8	IM 1071	IM V5	IM 1011
IM B9	IM 9101	IM V6	IM 1031
IM B10	IM 4001	IM V8	IM 9111
IM B14	IM 3601	IM V9	IM 9131
IM B15	IM 1201	IM V10	IM 4011
IM B20	IM 1101	IM V14	IM 4031
IM B25	IM 2401	IM V15	IM 2011
IM B30	IM 9201	IM V16	IM 4131
IM B34	IM 2101	IM V17	IM 2111
IM B35	IM 2001	IM V18	IM 3611
		IM V19	IM 3631
		IM V30	IM 9211
		IM V31	IM 9231
		IM V35	IM 2031
		IM V37	IM 2131



a b

Fig. 4

3. FUNCTIONALLY DIMENSIONING OF ELECTRICAL MOTOR

Mounting parameters $\boldsymbol{P_i}$ one assembled unit is directly related to how its installation. They are indicators of the quality of the assembled unit. They obtained after assembly of the device – through the implementation of combined teams dimensional chains. Determining the mounting parameters $\boldsymbol{P_i}$ and solving their dimensional chains

is an important stage in the design documentation of the items is called size – precision analysis. The purpose of this assay is to achieve a reasoned dimensioning of the functional devices.

In Fig. 5 shows the induction motor with an indication of the mounting arrangements **IM B3**, feet (feet down), and identified and labeled two installation parameters $\boldsymbol{P_{1f}}$ and $\boldsymbol{P_2}$. Parameter $\boldsymbol{P_{1f}}$ is functional mounting parameter related to the functioning of the electrical machine and depending on how its mounting arrangements. Its determination is necessary to have information about the installation the motor and how the motor will be connected to the machine which he will drive.

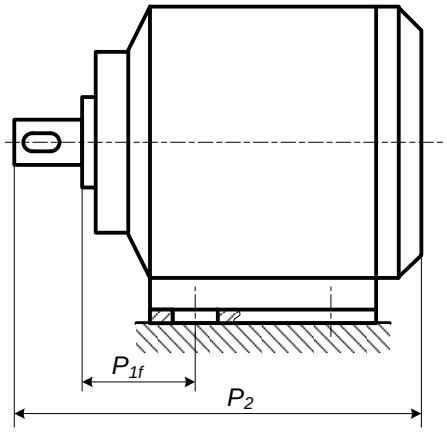


Fig. 5

4. CONCLUSION

Of analysis performed it is clear that the correct approach to the functional design of the electric motor is necessary to consider its working position and mode of mounting. In their studies students in field "Electrical Engineering and Automatics" developed by task assignment "Functional dimensioning in Electro technical assembled unit". The authors believe that it is appropriate first students to acquaint themselves with the working position and mounting arrangements of the electric motor. Then determine the mounting parameters of the assembled unit and perform functional dimensioning the electric motor. So developing of the assignment will follow the natural course of the construction activity.

References

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Reviewer: Assoc. Prof. PhD S. Guninski