APPLICATION EDGE
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REPLACING INDUCTION MOTORS

Considering the long history of electric motors powering our industrial world, it's no surprise when the need arises to replace a large induction motor. Below we review details that should be considered when attempting to replace an outdated or failed machine with a new induction motor.

There are numerous factors that could lead to the replacement of a motor. These include end of life, defects, a desire to operate at higher efficiencies, or a demand to achieve higher power factors. Every case is different and specific to each operation, however, there are universal considerations that need to be accounted for when upgrading a large induction motor.

Frames within the NEMA range of small to medium industrial motors are not complicated to replace due to the dimension standards ensuring the motor of one manufacturer will fit the same as another motor brand. However, large motors do not have dimensional standardization.

Unless the end-user intends to rebuild the foundation, these high-power ratings and frame dimensions require detailed attention to verify the mechanical interchangeability of an upgraded motor, in addition to an accurate evaluation of the electrical performance.

The following are critical mechanical and electrical considerations required to ensure a successful transition when replacing large motors.

Mechanical

Figures 1-a/b and 2 illustrate the dimensions that the replacing motor needs to match to be considered a "drop-in replacement motor." The descriptions of each dimension in Table 1 explain their relevance. Included is a column to indicate the similar nomenclatures of the IEC standard.

Motor manufacturers must ensure the proposed replacement motor is capable of matching shaft dimensions, shaft height, the position of assembly holes, and the BA dimension. All other dimensions may vary.

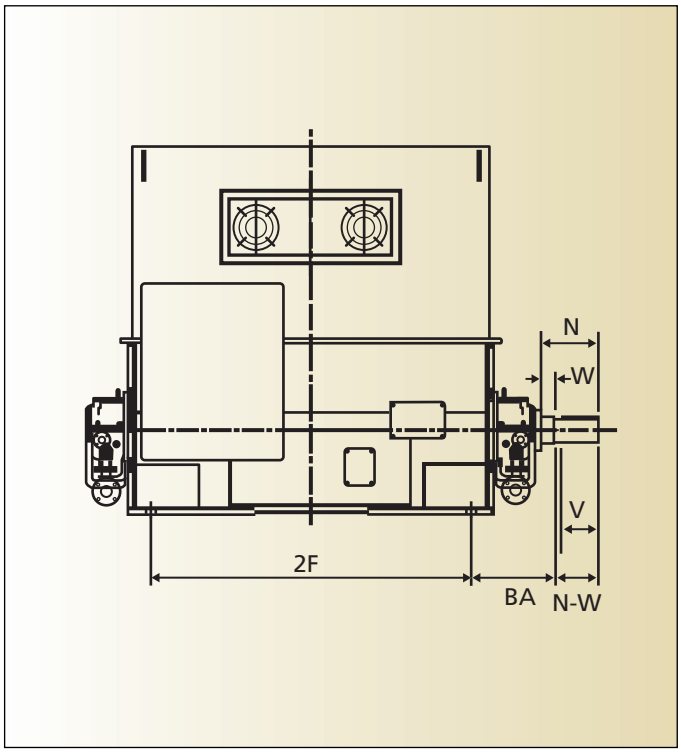

Figure 1-a. Motor side

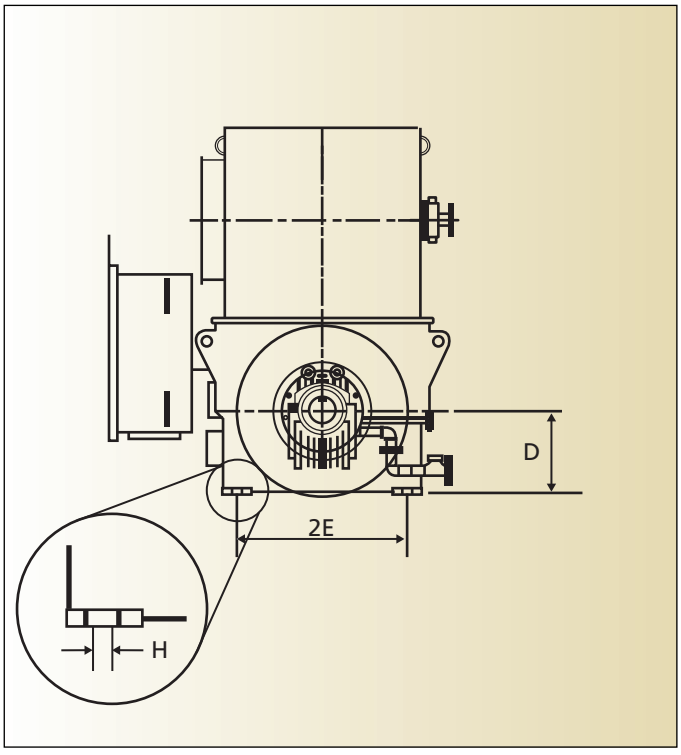

Figure 1-b. Motor end view

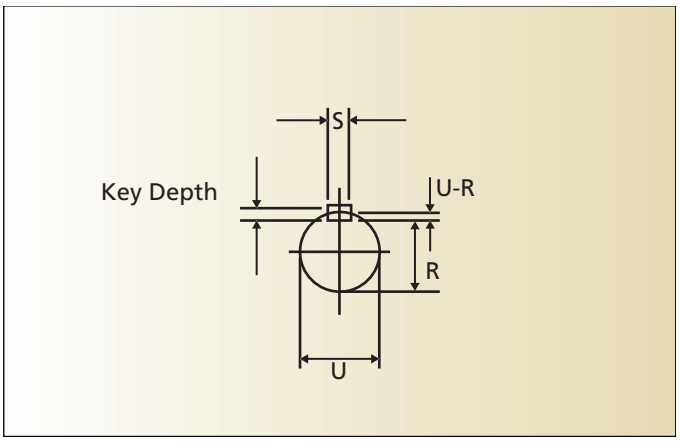

Figure 2. Shaft details

It is the responsibility of the motor owner to ensure the new motor does not interfere with equipment surrounding the motor such as pipes, and other utility and architectural structures. If provided the opportunity for a site walk through, the manufacturer's application engineer can assist in observing space limitations.

It is not uncommon for the motor owner to request the location of terminal boxes to be closer to the existing terminal boxes and connections. Committing to a perfect match is risky and should not be considered by the manufacturer. The owner of the motor can consider using flexible conductor segments

NEMA letter	Equivalent IEC letter	Description
2E	**A**	The distance between centerlines of mounting holes (end view)
2F	**B**	The distance between centerlines of mounting holes (side view)
D	**H**	The centerline of the shaft to the bottom of feet
H	**K**	The diameter of the assembling holes on the feet
BA	**C**	The distance from the centerline of the mounting hole in the nearest foot to the shoulder on drive end shaft. If no shoulder, it's the centerline of nearest foot mounting hole to the housing side of the N-W dimension
U	**D**	The diameter of the shaft extension
S	**F**	Width of keyset
R	**G**	Bottom of keyset or flat to the bottom side of shaft or bore
U-R	**GE**	The depth of keyway at the crown of the shaft extension at the drive end
V	**....**	The length of the shaft available for the coupling hub. On a straight shaft, this value is the minimum
W	**....**	Distance from end of the housing to shoulder on both tapered and straight shafts (when no shoulder exist, it's a clearance to allow for all manufacturing variations
N – W	**E**	Length of the shaft extending from the shoulder at the drive end

Table 1

to yield easier field assembly.

When applicable, water and oil inlet and outlets should be located on the side of the motor with existing connections, but adjustments to incoming pipes may be required. It is important to inform the owner of this possibility ahead of time, no later than the proposal stage.

Throughout the initial process, the application engineer on the project will use the existing motor outline drawing to evaluate and quote a frame with matching dimensions. If no drawing exists, the motor manufacturer cannot guarantee the interchangeability.

On occasion, motor owners may be willing to accept a motor with dissimilar dimensions and make the necessary site adaptations. It's important to understand the deviations owners are willing to accept. It may not be required to provide a "drop-in replacement." Even if this is the case, performance is still a must, unless the driven equipment is changing.

Transition Base

When the shaft height of the replacing motor is below the height of the existing unit, it may be possible to provide a transition base to match the foundation holes. The opposite makes a direct replacement impossible without altering

the foundation. Always work closely with the application engineer for certainty.

Coupling

Most motors couple directly to fans, compressors, pumps, and other process machinery. In this case, the outline drawing of the existing motor will provide the necessary shaft dimensions. However, in applications where the motor couples through a sheave and belt or a fluid coupling, the motor manufacturer should request details in addition to dimensions of the shaft.

In most cases, due to radial forces applied to the shaft, belt-sheave couplings require a particular bearing, end shield, and a shaft made of high strength steel that are, in most cases, not included in standard products. Figure 3 and Table 2 provide a checklist for belt and sheave data collection that should be considered by motor owners before sending a quote request to the application engineer.

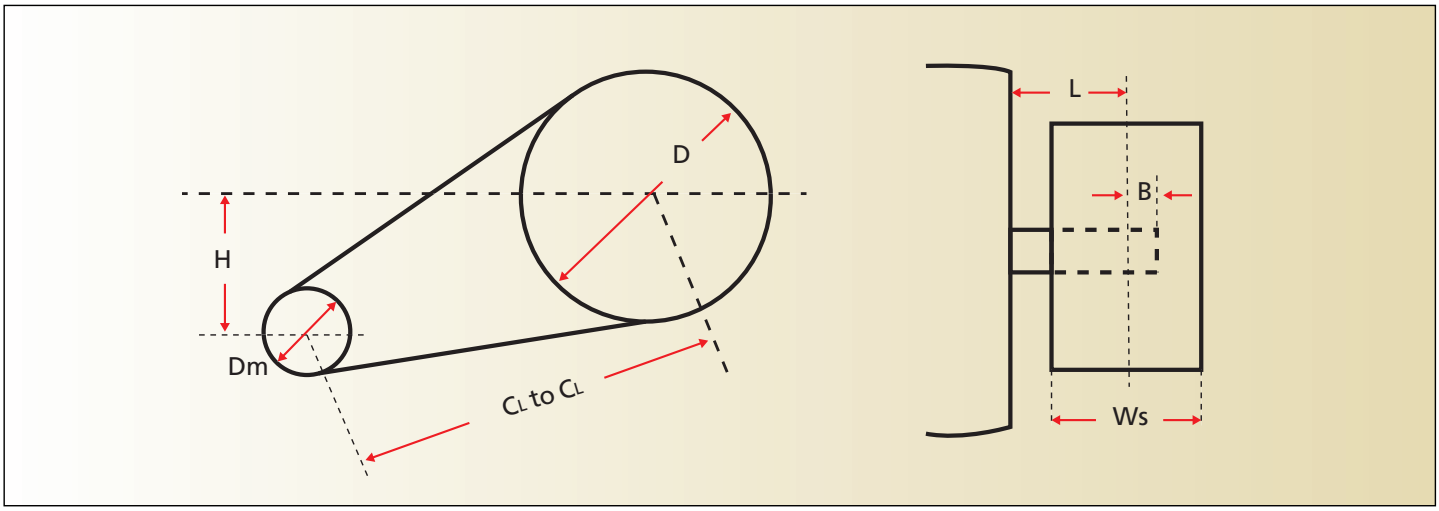

Figure 3. Belt and Sheave data requirements

Nomenclature	Description	Inches
Dm	Motor sheave pitch diameter [in]	
D	Driven sheave pitch diameter [in]	
CL to CL	Center to center distance between sheaves [in]	
Ws	Face width of motor sheave [in]	
L	The distance between the centerline of the motor sheave and end shield [in]	
B	Distance from end of the motor shaft to CL of sheave face [in]	
H	Height between motor shaft CL and driven shaft CL [in]	
	Also, the following information is required	
	Type of driven load	
	Inertia (LbFt²) of driven load referred to the motor shaft (speed)	
	The weight (Lb) of motor sheave	
	Number of belts	
	Belt size [in]	
	Belt type	

Table 2.

Accessories

Unless specifically requested, the motor owner can request the same model be provided to ensure the same controls and interfaces are used.

Color

Some facilities have color-coded equipment. Before the issuance of a proposal, manufactures should ask whether the client permits the use of the motor manufacturer's standard color. If not, manufacturers will request the Munsell or RAL color codes.

Electrical Performance

Torque is of vital importance to a successful motor replacement. The new motor must be able to accelerate and drive the existing equipment without exceeding the limits of temperature. In some cases, too fast of an acceleration is detrimental to other equipment. The new motor must provide enough breakdown and locked rotor torque values, as well as the same RPM, power, and current. Newly developed motors should provide equal or better efficiency when compared to legacy equipment.

To evaluate motor suitability, the owner must provide the speed-torque curve of the existing driven equipment, plus the total inertia on the motor shaft. In many cases, this information is not available from the driven equipment manufacturer. The motor owner should provide records of the original motor's data sheet, speed-torque curves, and thermal limit curves for the motor application engineer to consult.

Photography of the existing motor's nameplate is of no use.

Replacing Motors of the Same Manufacturer

Replacing motors of the same make and model could be perceived as being risk free and relatively straightforward. Many people assume the only necessary information is the corresponding motor model number. However, even in these cases there are potential risks.

Consider, for example, an original motor that has been modified. If the motor's original nameplate is secured to the frame and provided as the motor identity and only frame of reference to the application engineer, the miscommunication could result in delays and extra cost. It is essential to understand if the motor to be replaced was ever modified and if so, take those alterations into consideration.

Conclusion

Understanding the necessary considerations to accurately evaluate the requirements for replacement of large motor frames has many advantages. Among them, ensuring a trouble free motor replacement for owners and allowing manufacturers to prepare precise responses to quotation requests.

For specifications not mentioned here, contact TMEIC

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All specifications in this document are subject to change without notice.
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