Frameless Motor Mounting and Installation

This procedure provides guidelines for the mounting and installation of frameless motors.
DISCLAIMER: these instructions represent general guidelines only.

Handling and Storage

Handling and storage of motor components is very important. It is recommended that stators and rotors be stored in their original packaging until installation is required. Special care must be taken while handling stator assemblies. Damage to the coil insulation and lead wires can result in electrical shorts and possible electrical shocks. Precautions must also be taken while handling the rotor assembly, as strong magnet forces are present. Magnets can be chipped, cracked or broken if the rotor is dropped or large magnetic objects and other rotors are suddenly attracted to the rotor.

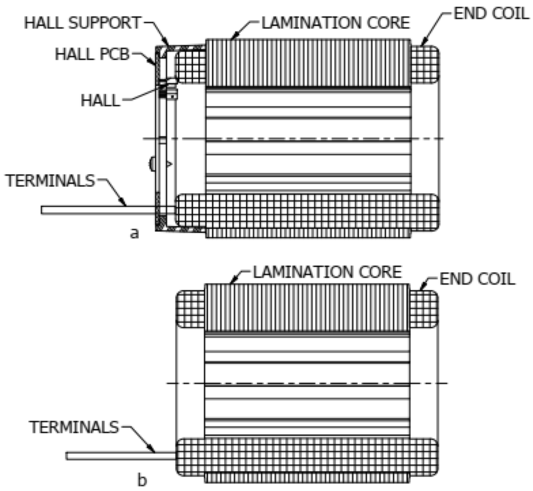

Fig.1. a. Stator with hall. b. stator without hall

Description

Refer to Fig. 1 and Fig. 2.
Frameless motors are supplied as two separate components, stator assembly and rotor assembly. The stator assembly consists of a laminated stator core with insulation fiberglass paper, coil, slot wedge and 3 stator leads. Depending on the design and/or customer preference the stator assembly may also contain 3 hall effect sensors with 5 leads and a thermistor or thermal switch. A circuit board containing the hall sensors and leads may be attached to the coil end turns. The rotor assembly consists of a magnetic rotor hub and magnets. The design may also require a nonmagnetic sleeve around the magnets made from fiberglass or aramid.

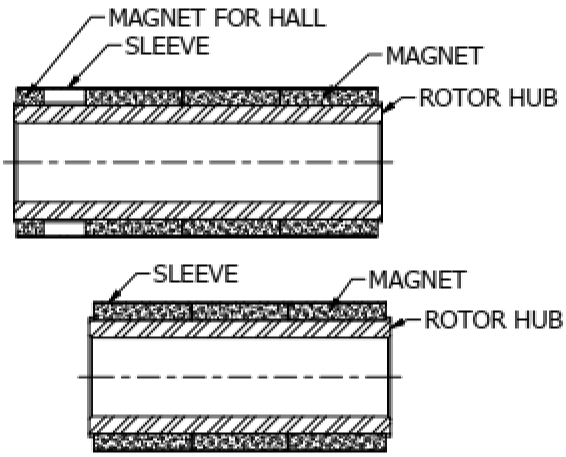

Fig. 2. Above-Rotor with hall magnet.
Below-Rotor without hall magnet

Motor Design Layout

Refer to outline drawing, Table 1 and Fig. 3.
When laying out the motor design, refer to the mounting dimension on the outline drawing to ensure the rotor and stator are axially aligned. For the Hall sensor option, an extra set of small magnets are placed at a certain distance in order to trigger the hall sensors. Maximum radial misalignment or concentricity between the rotor and stator is 0.1mm TIR. (Total Indicator Reading). Angular misalignment will vary with the stator stack length.

TABLE 1. ANGULAR ALIGNMENT	
STACK LENGTH	ANGLE
MIN. to 16.5	0.3 DEG
16.53 to 26.7	0.2 DEG
26.7 to 46.9	0.12 DEG
Over 47	0.07 DEG

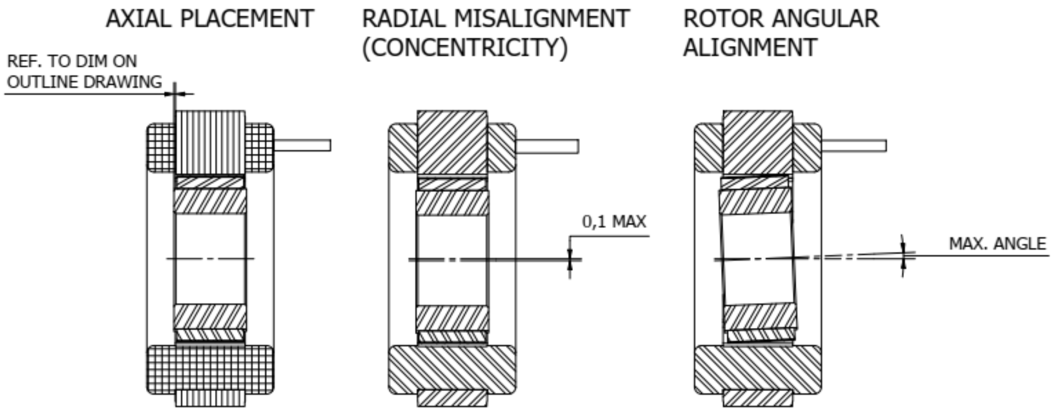

Fig. 3

Refer to Fig. 3. Table 1. The size and application of the motor will dictate the type of bearings required. Consult bearing catalog or manufacture for the proper size and type.

Stator Mounting

Refer to outline drawing and Fig. 4.
Stators can be mounted to shafts by various methods. Clamping, bonding and shrink fit methods will be addressed in this procedure.

Clamp method

The stator assembly can be mounted between two end bells. End bells can be produced by either machining a solid piece of stock or through a die-casting process. In either case the end bells must be designed to provide a rigid and stable support for the stator and rotor assembly.
Stators are supplied with a mounting surface machined on each end of the stator core. The mounting surface on the end bell must be designed to the following criteria:

- The outside diameter of the end bell shoulder is equal to the maximum stator O.D. $+0.02\ H8$.
- The inside diameter of the shoulder is equal to the max. stator core mounting diameter $+0.2\,{}^{+0.12}_{-0}$.
- The depth of the shoulder is suggested at 3mm min. up to ½ the stator core length. A clearance gap of 4mm minimum (depends on the voltage) must be provided between the end coils and the end bell wall. A greater clearance gap will provide easier installation of the lead wires and may be necessary depending on lead wire exit.
- A grommet/strain relief should be used at the lead exit to protect lead insulation from chafing and protect leads from any tensile forces.

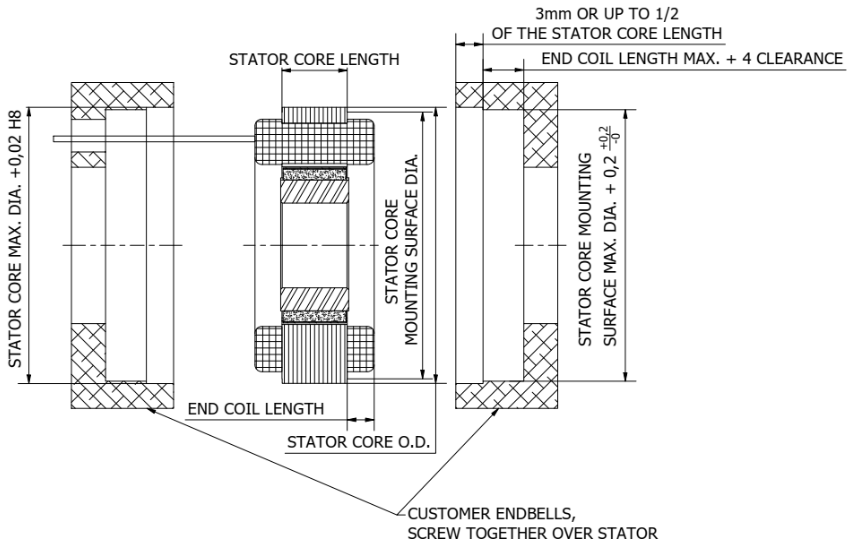

Fig. 4

Bond method

Besides clamping between two endbells, the stator can also be fixed in a regular housing with an I.D. of STATOR CORE MAX. DIA. + 0.02 H8 and bonding the stator to the housing with an adhesive (i.e. Loctite 648).

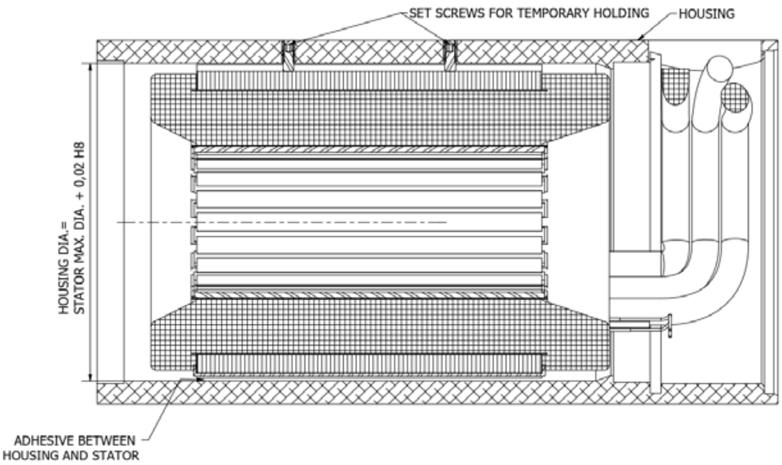

Fig. 5

Shrink fit method

Another method for mounting the stator in a housing involves shrink fit, where the aluminum housing is heated up to 250-300°C and placed over the stator and the I.D. of housing should be STATOR CORE MAX. DIA.$-\mathbf{0.05}\,{}^{\mathbf{-0.04}}_{\mathbf{-0.02}}$ for diameters **below Ø100** and $-\mathbf{0.1}\,{}^{\mathbf{-0.04}}_{\mathbf{-0.02}}$ for diameters **above Ø100**.

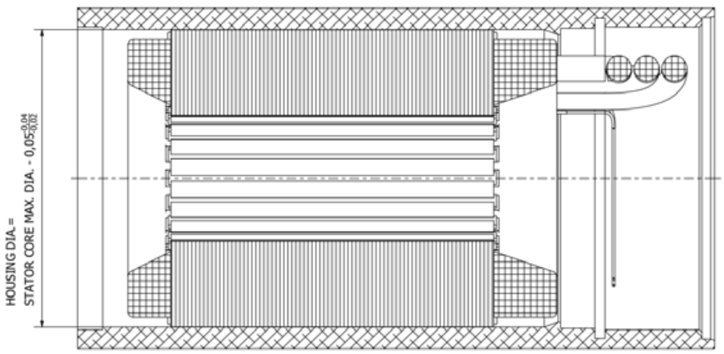

Fig. 6 Example for Shrink fit method (stator O.D.<100)

Rotor Mounting

Refer to outline drawing and Fig. 7, Fig. 8, Fig. 9 and Fig. 10.

Rotors can be mounted to shafts by various methods. Clamp, bond and press will be addressed in this procedure. The rotor ID is manufactured per the customer specification or to the standard catalog diameter. The shaft diameter for each method is equal to the rotor ID – 0.025. Clearance range between shaft and rotor should be 0.005mm min. to 0.05mm max.

Clamp Method

This method involves holding the rotor to the shaft with force exerted through a thrust disc and machine screw. A lock washer or bonding agent can be applied to prevent the screw from becoming loose. The number of screws will depend on the size of the rotor, torque requirements and customer application. Applications involving high torque or sudden start and stop modes may require a woodruff key or square key along with the clamp.

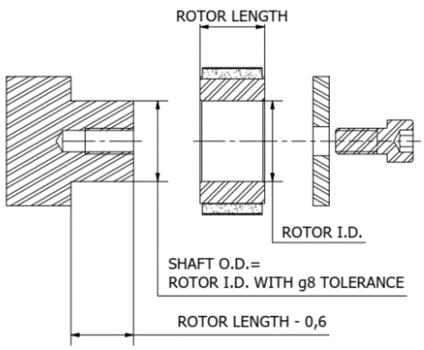

Fig. 7 Method for clamping small rotors.

Bond Method

This method involves holding the rotor to the shaft with a high strength retaining compound (i.e. Loctite 648). Adhesive manufacturers produce retaining compounds specifically for this design and should be consulted to help select the correct retaining compound for your application. – Fig.8

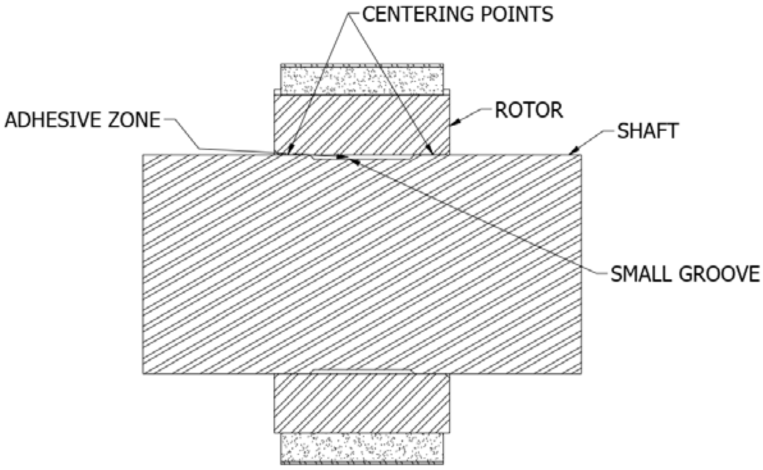

Fig. 8

Press Method 1

This method involves holding the rotor to the shaft with an interference fit between a set of serrations on the shaft and the rotor ID. A set of 4 serrations equally spaced around the outside diameter of the shaft is required. The diameter over the serrations is equal to the rotor I.D. $\frac{+0.076}{-0.025}$. Serration length should be no less than ¾ the length of the rotor. A tapered serration is acceptable.

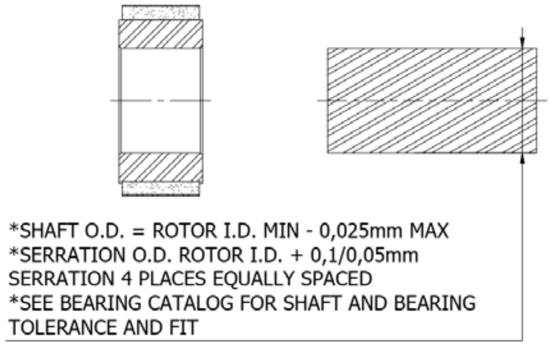

Fig.9

Press Method 2

Another press method is by using an intermediate component called tolerance ring BN TYPE (picture below), the shaft having a special feature where tolerance ring is placed (see tolerance ring catalog from manufacturers).

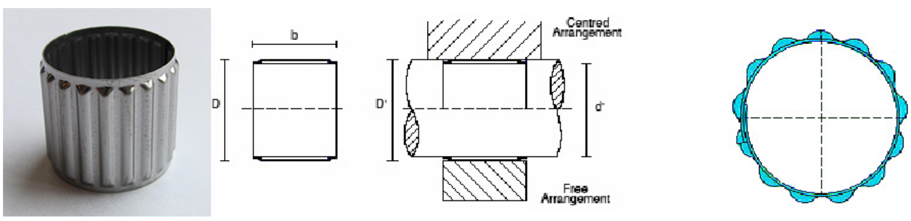

Fig. 10