

Installation and Maintenance Manual

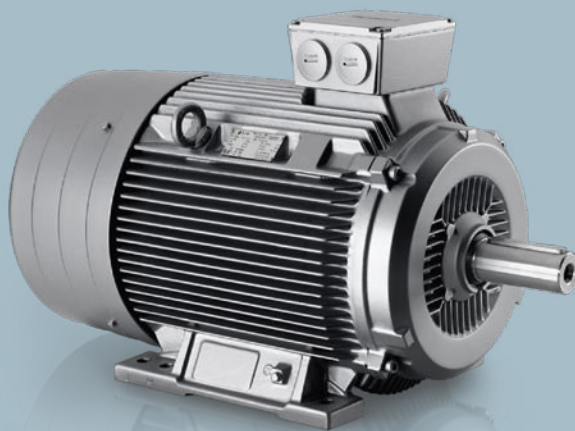
安裝與維護手冊



1LG0 低壓交流非同步電動機

Answers for industry.

SIEMENS



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1.0 簡介

1.1 應用範圍

1LG0 標準電機的防護等級達到 IEC60034-5 標準中 IP55 防護等級的要求（見銘牌標註），適用於灰塵及潮濕的工作環境。如果電機安裝或儲存於戶外，有必要增加相對應的防護裝置，以避免受長期強烈的陽光曝曬、雨水的侵蝕、以及冰雪和灰塵對電機造成的影響。

相關使用環境條件如下：

- 海拔高度 $\leq 1000\text{m}$
- 環境溫度 $+40^{\circ}\text{C}$
- 操作環境溫度 $-20^{\circ}\text{C} \dots +40^{\circ}\text{C}$
- 相對溼度

環境溫度	相對溼度
$-20^{\circ}\text{C} \leq T \leq 20^{\circ}\text{C}$	100%
$20^{\circ}\text{C} < T \leq 30^{\circ}\text{C}$	95%
$30^{\circ}\text{C} < T \leq 40^{\circ}\text{C}$	55%

註：如果使用環境條件和以上不同時，請諮詢西門子。

本系列電機符合 GB18613-2006《中小型三相非同步電動機效能限定值及效能等級》標準，效能等級為 3 級，具體規格的耗能指標參見銘牌。

1.2 冷卻方式

自冷卻方式（標準配置）：冷卻方式 IC411，符合 IEC/EN 60034-6 標準要求。

1LG0 電機為全密封自冷卻（雙向風扇）型式電機，在使用時確保電機具有足夠的冷卻風量。如果使用外部風扇，必須在安裝風扇時確保合適的冷卻風向。

強製冷卻方式（選用配件）：冷卻方式為 IC416，滿足 IEC/EN 60034 標準要求。
















電機冷卻是通過一個獨立的風扇（強制通風）來達到的。這種強制冷卻不受機器運行狀態的影響。

- 注意!
- 1) 確保獨立風扇氣流順暢，且與週圍環境氣流方向一致；
 - 2) 獨立風扇須由一個獨立電源模組供電，並且確保風扇的轉向與其風扇罩上附帶的轉向標誌指示的方向一致；
 - 3) 獨立風扇不能通過變頻器驅動；
 - 4) 電機啟動前，先啟動獨立風扇，然後啟動電機；電機停機時，先關閉電機電源，待電機停止運轉後斷開獨立風扇驅動電源。

1.3 安裝結構型式

電機銘牌上標出了其安裝結構型式。

警告! 在運輸過程中，電機須經由吊環或電機結構指定位置進行吊裝搬運。

基本安裝類型	示意圖	適用範圍（機框號）	其他安裝類型	示意圖	適用範圍（機框號）
IM B3 (IM 1001)		80mm~355mm	IM V5 (IM 1011)		80mm~160mm
			IM V6 (IM 1031)		80mm~160mm
			IM B6 (IM 1051)		80mm~160mm
			IM B7 (IM 1061)		80mm~160mm
			IM B8 (IM 1071)		80mm~160mm
IM B5 (IM 3001)		80mm~315mm	IM V1 (IM 3011)		80mm~355mm
			IM V3 (IM 3031)		80mm~160mm
IM B14 (IM 3601)		80mm~112mm	IM V18 (IM 3611)		80mm~112mm
			IM V19 (IM 3631)		80mm~112mm
IM B35 (IM 2001)		80mm~355mm	IM V15		80mm~160mm
			IM V36		80mm~160mm

註：對於其他特殊的安裝結構型式，請諮詢西門子。

2.0 搬運及儲存

在運輸電機時，必須用所提供的吊環來搬運。在搬運電機之前，請確保吊環安裝正確且牢固，但切勿使用電機軸和風扇罩來搬運電機。另外，電機升降時必須注意避免搖擺和震動，以防造成軸承受損。

建議所有的電機應該儲存在乾燥無塵的環境之下，並避免過多的震動。

如果電機驅動端和非驅動端採用封閉式軸承，若電機出廠儲存 2 年或超過 2 年，建議更換軸承；如果電機有再潤滑裝置，若電機出廠後儲存 2 年或超過，建議更換潤滑油脂。

如果電機在灰塵及濕度較大環境下儲存時間超過 2 年，電機的使用壽命將會降低。對於這種情況，必要時在電機安裝和啟動前，對其絕緣系統進行檢測，從而保證其可以正常穩定的運行（相關參考值，見 3.5）。

加工表面（法蘭表面，軸端表面等）已在工廠進行防腐蝕處理，但是在電機儲存時仍需做必要的防腐措施。建議經常轉動一下電機軸，使軸承潤滑脂分佈均勻。

3.0 調試



所有工作都必須由熟練工人進行操作。電機做任何操作工作之前，確保電機與主電源及輔助電源斷開。並且，確保電源不被意外開啟。

3.1 安裝

電機安裝完畢後必須將吊環旋緊。

當電機垂直安裝且電機軸驅動端向下時，建議在非驅動端增加防護罩，從而可以避免水及其他外部物體進入風扇罩，從而影響電機散熱。

當電機垂直安裝且驅動端軸朝上安裝，建議做必要的防護措施，以防止液體沿電機軸進入電機。

安裝電機時必須注意安裝在堅實穩定的基座上，以避免過度震動引發軸承故障。

3.2 接線盒

接線盒安裝於電機頂部或側面（左側或右側），可以作 $4 \times 90^\circ$ 方向旋轉，便於電纜多角度引入。

3.3 動平衡與聯結

為了確保安靜、無震動的運行環境，對傳動聯結件（聯軸器、滑輪、風扇、變速器等）須進行適當的軸向、徑向校正。

1LG0 電機轉子動平衡方式為半鍵平衡。動平衡方式在電機銘牌上有標註（H 表示半鍵平衡）。

- 注意！
- 1) 為確保無震動運行，傳動聯結件的動平衡方式為半鍵平衡；
 - 2) 在調整傳動聯結件配合過程中，須考慮聯結件與電機的溫度環境；
 - 3) 當電機啟動前沒有聯結任何傳動件時，電機軸上的鍵必須移除。

3.4 電氣連接



所有工作都必須由熟練工人進行操作。電機做任何操作工作之前，確保電機與主電源及輔電源斷開。並且，確保電源不被意外開啟。

所有電機的接線盒內都有六個電源線接線端子和一個接地端子，其中框號為 315mm~355mm 範圍電機的機殼上還有另外一個接地線。所有電機都適合雙向轉動（正轉或者反轉），並且通過調整其中兩相電的順序即可將電機轉向。

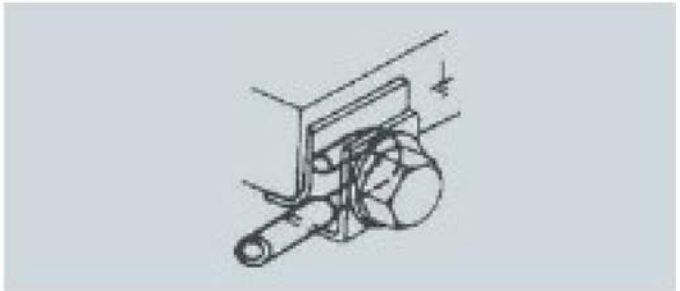
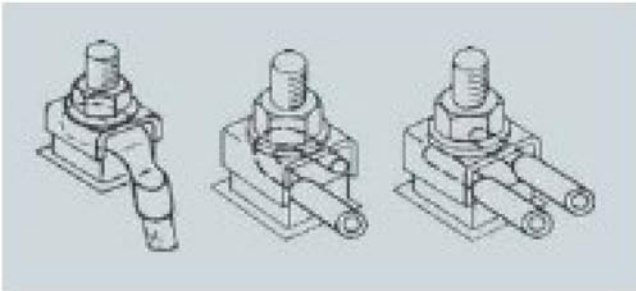
電源連接

1LG0 三相非同步電動機線圈可連接成星形、三角形。

對於正確運行，允許電壓偏差為 $\pm 5\%$ ，頻率偏差為 $\pm 2\%$ 。

電纜連接示例

框號 315mm~355mm 電機機殼外接地線



關於接線端子的旋緊力矩，請參照表1中接線端子旋緊力矩大小以及方向。



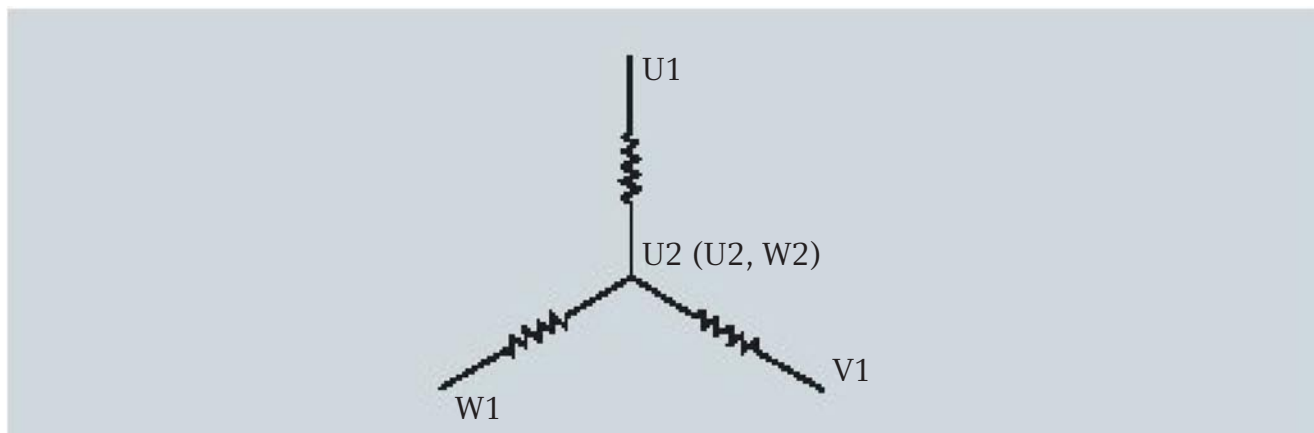
表 1

尺寸	M4	M5	M6	M8	M10	M12	M16
轉距 (Nm)	1.2	2.5	4.0	8.0	13	20	40

註：旋緊力矩 (Nm，公差： $\pm 10\%$)

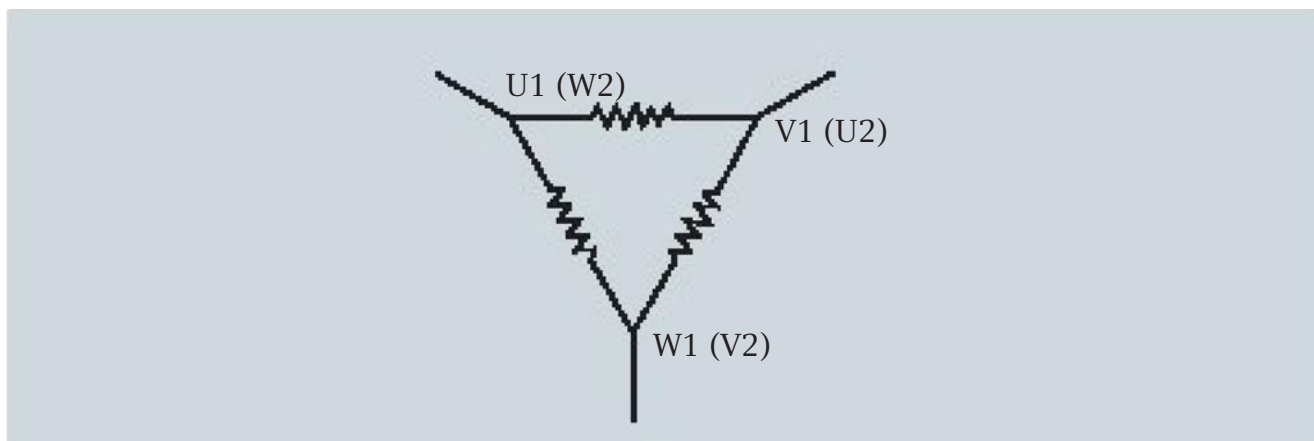
星形連接

星形連接是通過繞組接線端子 W2、U2 及 V2 相互連接，U1、V1、W1 端連接電源而成，如下圖所示。



三角形連接

三角形連接是通過三相繞組的端子首尾依次相接而成，如下圖所示。



註：若接線盒的輔助或主進線孔由電纜頭密封，需要用標準的扳手來旋開。

繞組保護

1LG0 電機有兩種形式的繞組保護：

- PTC 熱敏電阻 —— 用於報警或跳脫保護
- PT100 測溫電阻 —— 用於測定軸承或繞組溫度

注意！ PTC 熱敏電阻和 PT100 測溫電阻都需要與外部控制單元進行聯結。

警告!

當 PT100 熱敏電阻用於軸承溫度監測時，報警和跳脫溫度值與電機線圈絕緣等級無關。

輔助接線端子

如電機配置 A11、A12、A60、A61、A72、K45 選件中的一個或幾個時，其引線端標識如表 2 所示。

表 2

A11		A12				A60						A61						A72				K45							
PTC		PTC		PTC		U		V		W		U		V		W		軸承測溫元件				防潮 加熱 線圈							
C1	C2	C1	C2	C3	C4	T1	T2	T3	T4	T5	T6	T1	T2	T7	T8	T3	T4	T9	T10	T5	T6		T11	T12	T13	T14	T15	T16	P1
						T1	T2	T3	T4	T5	T6	T1	T2	T7	T8	T3	T4	T9	T10	T5	T6	T11	T12	T13	T14	T15	T16	P1	P2

註：對於 A12 選件，端子 C1、C2 用於跳脫，C3、C4 用於報警。

在溫差比較大的環境中，電機停止一段時間將比較容易產生冷凝水。因此，強烈建議在這種情況下為電機加選防潮加熱線圈（選件號：K45）。

警告!

防潮加熱線圈切勿在電機運轉時加熱。

3.5 檢查絕緣電阻

在初次啟動電機前或者經過長時間（6 個月）停機後，建議在開啟電源啟動之前對相位間的絕緣電阻進行測量。

警告!

絕緣電阻測量完成後的短時間內，接線端子還可能帶有一定的危險高電壓，請勿直接觸摸。

絕緣電阻

最小絕緣電阻：新電機或繞組維修後的電機對地電阻為 10 MOhms。

臨界電阻：臨界電阻的計算方法為額定電壓乘以係數，如額定電壓 690V 電機臨界電阻可計算如下

$$\text{臨界電阻} = 0.69 \text{ kV} * 0.5 \text{ Mohms/kV} = 0.345 \text{ Mohms}$$

測量方法

最小絕緣電阻的測量：繞組對地電阻的測量可以通過對繞組施加 500V 直流電壓來測量，繞組溫度需保證在 25°C ± 15°C。

臨界電阻的測量：臨界電阻的測量必須在電機運行溫度的情況下對繞組施加 500V 直流電壓。

常見的絕緣電阻故障原因及處理方式主要有如下 2 種情況。

故障原因 1：可能是由於環境潮濕引起的。

處理措施 1：需要將繞組進行烘乾處理。

故障原因 2：電機經過長時間運行後（電機處於熱機狀態），最小電阻值可降低。

處理措施 2：如果測量值低於臨界電阻值，必須對電機進行更換或修改。

3.6 變頻器應用



在電機負載轉矩不穩定時（如活塞式壓縮機，負載），必然會導致非正弦電流，該電流的諧波會對系統造成影響，而產生過多干擾。

電磁相容性

當變頻器驅動電機時，電磁干擾的程度大小取決於變頻器的類型（種類，IGBT 數量，干擾控制措施及製造商）、佈線、距離以及應用需求。

在設計和應用階段必須參考變頻器製造商關於電磁相容性的安裝指導。



如果使用變頻器驅動電機，轉速超過電機額定轉速時，必須考慮對電機的機械零部件及傳動聯結件的影響。

更多內容，請參考 IEC 60034-1。

噪音，溫升和振動

電機在變頻運行時，電機噪音、溫升將會有所增加。

變頻應用時，可能會由於轉速高於額定轉速，電機機械振動加大，從而使機械運轉的平穩性發生變化。這樣也會導致軸承和潤滑脂的壽命降低。

4.0 維護



對電機進行維護操作前，電機必須對主電路以及相關的輔助電路隔離。

“5 項安全規則”（如在 DIN VDE 0105 中規定的）如下：

- 設備與電源隔離
- 採取有效措施防止再次連接
- 確認設備停止運行
- 確保電機正確接地
- 隔開相連的運動部分

以上所列的規則應一直保持到所有電機維修維護工作全面結束，並組裝完成。

4.1 軸承壽命

在正常運行條件下，電機水平安裝且不受任何軸向力的情況下，電機軸承壽命至少可達到 40000 小時；在電機承受允許徑向和軸向負荷時，電機軸承壽命至少可達 20000 小時。這裏所說的 20,000 或 40,000 小時指的是，電機在環境溫度不超過 40°C，按電機銘牌上標定的數據正常運轉的情況下可達到的壽命。

- 注意！
- 1) 環境溫度超過 40°C 後，每升高 10°C，潤滑脂的壽命降低一半。
 - 2) 電機在垂直安裝、外界環境非常惡劣、受外部機械振動或處於濕度比較大的環境中運行的情況下，潤滑油脂的壽命以及軸承的壽命將會縮短。
 - 3) 長期的儲存會降低軸承的壽命，電機在長期儲存超過 24 個月時，驅動端和非驅動端的封閉式軸承需要更換，開放式軸承需要重新注油。
 - 4) 若電機裝配開放式軸承，須按 4.2 部分中提到的潤滑時間間隔進行定期注油。

警告!

電機長期變頻高速運轉會將降低軸承和潤滑脂的壽命。

4.2 潤滑脂類型

潤滑脂類型：UNIREX N3（Esso），合成潤滑脂符合DIN 51825-K3N規定。

配有注油裝置的電機（選件號：K40），風扇罩上有單獨的注油銘牌。

4.3 潤滑脂壽命和再潤滑週期

框號“180mm~280mm”範圍內的電機，當電機運行在額定電壓和頻率下、環境較好的條件下，在軸承壽命期內潤滑脂無需更換。但當電機運行在環境比較惡劣的情況下時，建議用戶選擇添加注油裝置（選件號為 K40），再潤滑週期見表 3。

框號“315mm~355mm”範圍內的電機標準配置注油裝置，再潤滑週期見表 3。

表3

極數	框號	運行時間	預加潤滑油脂 (無需再潤滑)	可再潤滑
2, 4, 6	FS80-FS280	20,000 , 或 40,000 1) hrs	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	FS315	3,000hrs	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4,6	FS315	5,000hrs		<input checked="" type="checkbox"/>
2	FS355	2,000hrs		<input checked="" type="checkbox"/>
4,6	FS355	4,000hrs		<input checked="" type="checkbox"/>

註：對於 2、4、6 極且機框號為 180mm~280mm 的電機，只有配有注油裝置（選件號：K40）時才可進行再潤滑。

注意! 如果電機垂直安裝、運行時存在較大震動、有負載變化的情況或者經常變向操作，應該在比更的時間內更換潤滑脂。

4.4 再潤滑

警告!

在電機運行過程中或停止狀態進行註油時，必須遵守當地關於安全操作的相關規定！



添加潤滑油脂時，注意不能加過多的潤滑油脂，否則導致軸承溫度過高。

添加潤滑油脂過程中，切勿將灰塵或舊的潤滑油脂進入軸承中。

注意! 在添加潤滑脂之前，需要將注油孔中的舊潤滑脂清理乾淨。

建議在電機運行過程中保持工作溫度時，進行添加潤滑脂。

若在電機運行過程中不能添加潤滑脂，推薦先注入少量潤滑脂，然後旋轉電機使潤滑脂均勻分佈，當電機停下後，將剩餘的潤滑脂再注入。

如果電機軸驅動端軸承或非驅動端軸承過熱，建議檢查軸承熱損情況，如有必要，則需更換軸承或添加潤滑脂。

注意! 如果過熱，軸承脂顏色將會變暗。

4.5 軸承更換 —— 裝配與拆卸

當軸承壽命終了時，電動機運行的振動及噪音將明顯增大，檢查軸承的徑向遊隙如達到表 4 數值時即應更換軸承。

表4

電機機框號 (mm)	80 ~ 112	132 ~ 160	180 ~ 250	280 ~ 355
軸承內徑 (mm)	20 ~ 30	35 ~ 50	55 ~ 80	85 ~ 120
極限磨損遊隙 (mm)	0.1	0.15	0.2	0.3

注意! 更換新軸承的規格型號應與舊軸承相符。

拆下電機的必要部分，用專業的工具將滾動軸承拉出。

在安裝新的軸承之前，首先按照軸承生產商提供的相關說明對軸承進行預熱，然後將軸承裝入轉子軸。軸承更換後，舊軸封（V 型環或油封）也必須更換。

警告!

更換軸承時，嚴格禁止任何沖擊和擊打（例如用鋼槌等），以防損害軸承，造成過早損壞。

關於端蓋或法蘭上螺栓的旋緊力，請參照表 5 中螺栓的旋緊力矩大小及方向。

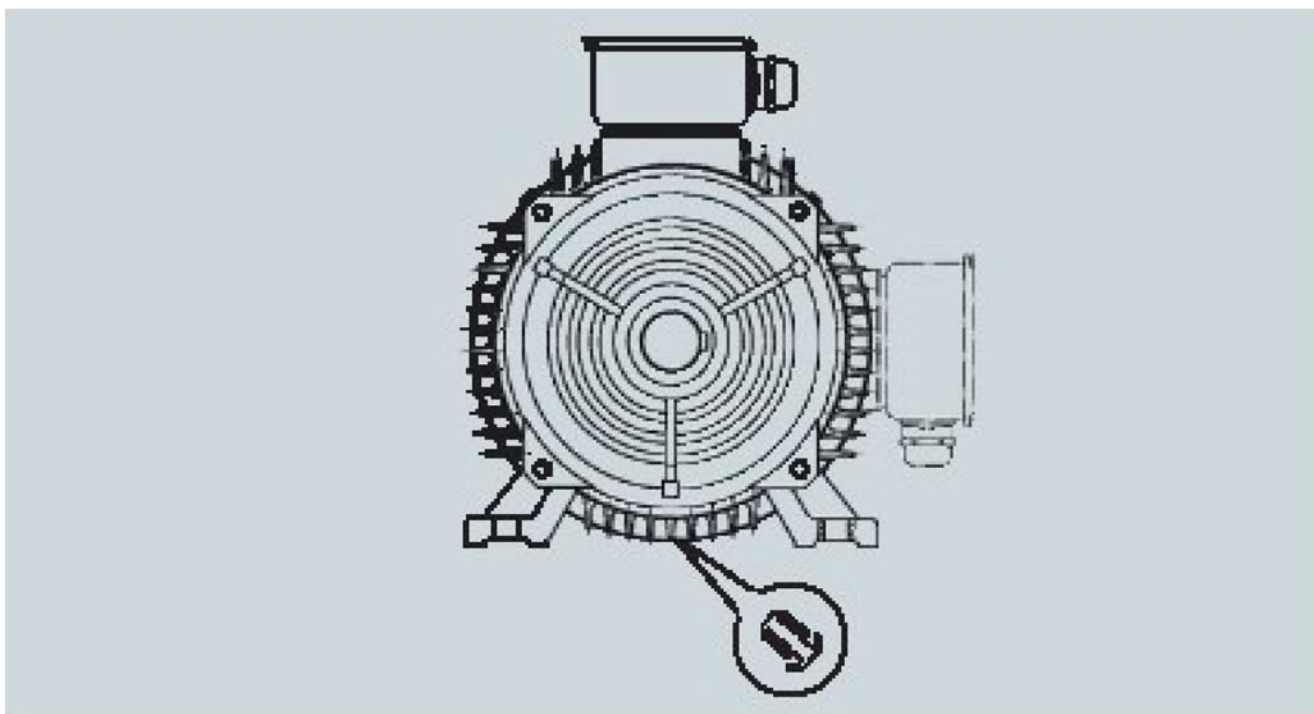
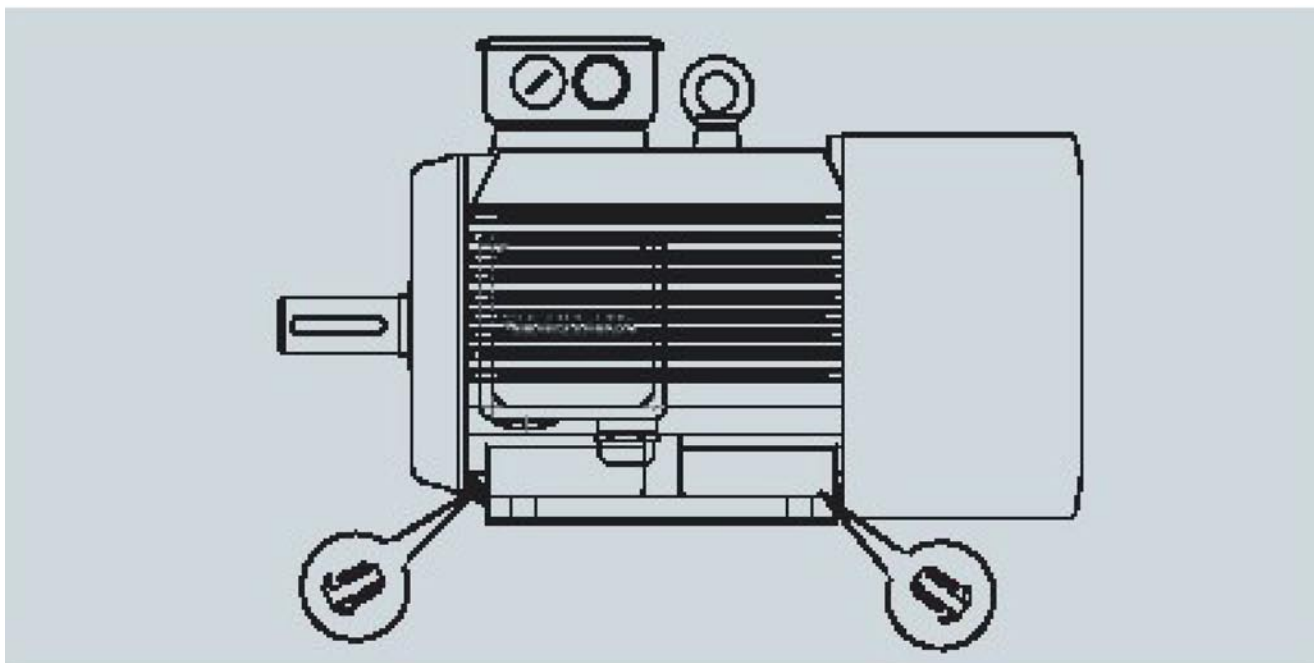


尺寸	M4	M5	M6	M8	M10	M12	M16	M20
轉距 (Nm)	2	3.5	6	16	28	46	110	225

註：旋緊力矩（Nm，公差：±10%）

4.6 排水孔

對於框號 160mm（含）以上的電機都有排水孔，並且排水孔在出廠時預先安裝好塑料塞。關於排水孔的位置，如下圖所示。



5.0 啟動

預備檢查

在電機第一次通電前，建議預先做一下幾個方面的檢查：

- 1) 確保螺栓旋緊，包括傳動聯結件上的螺栓；
- 2) 確保電機冷卻風扇沒有被卡住；
- 3) 若電機配有注油孔，確保軸承具有充分潤滑油脂；
- 4) 確保電源以及接線方式與銘牌標出直接啟動、緩啟動或變頻器啟動的數據一致；
- 5) 確保電機正確接地；
- 6) 若電機裝配有熱保護電阻或防潮加熱線圈，確保這些物件的電源端子接線正確。

當電機接通電源後，確保檢查電機的轉向以及空氣流通方向是否正確，以及電流、振動和噪音是否正常。



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The data and recommendations specified in all of the instructions supplied ("Information on safety and commissioning"), must always be observed in order to avoid hazardous situations and the risk of personal injury or equipment damage.

Furthermore, the pertinent national, local and plant-specific regulations and requirements should be kept in mind and observed!

Special designs may vary in technical details. If in doubt, please contact the manufacturer, referencing the type designation and serial number (see rating plate), or have the installation, service and maintenance work executed by one of the Siemens Service Centers.

1.0 INTRODUCTION

1.1 Application scope

Prescribed use of 1LG0 standard motors according to IEC 60034-5:

The standard motors are provided with degree of protection IP55 and can be used in a dusty and damp environment. A suitable canopy cover is recommended if the motors are installed outdoors with exposure to direct sunlight, rain, snow and ice.

Please refer to the following environmental application conditions.

- Installation Altitude ≤1000m ASL
- Ambient temperature +40°C
- Operating temperature range -20°C ~ +40°C
- Relative Humidity

-20°C ≤ T ≤ 20°C	100%
20°C < T ≤ 30°C	95%
30°C < T ≤ 40°C	55%

Note: If the ambient conditions and site altitude is different from the above mentioned, please consult with Siemens.

1LG0 series motors comply with GB18613-2006 «Minimum allowable values of energy efficiency and the energy efficiency grades for small and medium three-phase asynchronous motors». Energy efficiency grade of the motors are class 3, and the value of energy efficiency are shown on rating plate.

1.2 Motor construction and types

Self-ventilation (standard): Type of cooling IC411 in accordance with IEC / EN 60034-6 1LG0 motors are totally enclosed and self-ventilated (TEFC) by a bi-directional fan mounted on the NDE of the rotor shaft. Care must be taken to ensure adequate clearance for maximum air flow and cooling. If the optional external blower is used, the correct direction of air flow must be taken into consideration for proper cooling.

Forced ventilation (optional): Type of cooling IC416 in accordance with IEC / EN 60034-6

Cooling independent of the motor is achieved by means of a separately driven fan wheel (forced ventilation).

Forced ventilation is independent of the operating state of the machine.




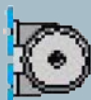


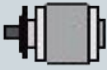








- Notice!
- 1) Ensure the air flow of the separately driven fan smooth, and consistent with external air flow;
 - 2) The separately driven fan is powered by an independent module. And it must be ensured that the rotation direction of the separately driven fan is consistent with the mark shown on fan cowl;
 - 3) The separately driven fan can not be powered through converter;
 - 4) It must be ensured that the machine is not operated without starting the external fan, and stopped before external fan stop.

1.3 Types of construction/method of installation

The type of construction of the machine is stated on the rating plate.

Warning!

During transport, machines may only be hoisted in a position corresponding to their basic type of construction.

Basic type of construction code	Graphics-Based Representation	Application Scope (Frame size)	Other methods of installation	Graphics-Based Representation	Application Scope (Frame size)
IM B3 (IM 1001)		80mm~355mm	IM V5 (IM 1011)		80mm~160mm
			IM V6 (IM 1031)		80mm~160mm
			IM B6 (IM 1051)		80mm~160mm
			IM B7 (IM 1061)		80mm~160mm
			IM B8 (IM 1071)		80mm~160mm
IM B5 (IM 3001)		80mm~315mm	IM V1 (IM 3011)		80mm~355mm
			IM V3 (IM 3031)		80mm~160mm
IM B14 (IM 3601)		80mm~112mm	IM V18 (IM 3611)		80mm~112mm
			IM V19 (IM 3631)		80mm~112mm
IM B35 (IM 2001)		80mm~355mm	IM V15		80mm~160mm
			IM V36		80mm~160mm

Note: About the special mounting construction type, please consult with Siemens.

2.0 HANDLING AND STORAGE

When lifting the motors, always use the lifting eyes provided. Prior to lifting the motor make sure that the lifting eyes are installed correctly and tightened. Never lift a motor using the rotor shaft and fan cowling. In addition care must be taken during lifting and lowering of the motor to avoid any shocks or vibrations which can result in bearing damages.

It is recommended that all motor be stored in a dry, dust free environment and free of excessive vibrations.

If the DE and NDE bearings are of the sealed types, it is recommended that they are replaced if storage has exceeded 2 years from date of motor manufacture. If the motors have the regreasable bearings, then the recommendation is to replace the grease after 2 years of storage.

The service life of the motor can be considerably reduced if the storage period extends beyond 2 years in environments with high moisture and dirt. If necessary, the insulation resistance of the winding could be measured determine the health of the motor prior to installation and start-up, (see Section 3.5. for reference values).

Machined surfaces (flange, DE rotor shaft) are treated at the factory with an anti corrosive agent to prevent rusting. However these surfaces should be retreated during storage as deemed necessary. It is recommended that the motor shaft is rotated by hand on a frequent basis to ensure even grease distribution.

3.0 COMMISSIONING



All work must be carried out by a skilled worker.

Before starting any work, be sure to isolate the machine from the main and auxiliary power supply as applicable.

Mains must be secured against accidental switch on.

3.1 Installation

Lifting eyes are screwed in place and must be tightened. If the motor is installed vertically with the DE shaft facing downwards, a protective canopy is recommended to cover the fan cowling. This canopy is necessary to prevent the ingress of water and foreign objects that may inhibit proper fan operation.

If the DE shaft is facing upwards, a protective canopy and / or suitable protective measures are recommended to be taken to prevent liquids from entering the motor windings via the shaft.

Care must be taken to install the motor on a solid foundation so as to avoid excessive vibration which can result in premature bearing failure.

3.2 Terminal box

Terminal box is either top or side mounted (LHS or RHS) on the motor and can be rotated 4 times by 90° thus allowing for multiple cable entry possibilities.

3.3 Balancing and coupling of transmission elements

To ensure a quiet and vibration free operation, proper axial and radial alignment of a balanced transmission element (coupling, pulleys, fans, gear box, etc.) is essential.

As standard, the 1LG0 rotors are dynamically balanced using a half feather key as indicated on the ratings name plate (H=Half Key).

- Notice!
- 1) The transmission and coupling elements are required to be half-key balanced to ensure a vibration free operation.
 - 2) Coupling and motor temperature considerations must be taken into account during alignment of the transmission.
 - 3) Key must be removed from the motor shaft prior to starting if no transmission is coupled.

3.4 Electrical connection



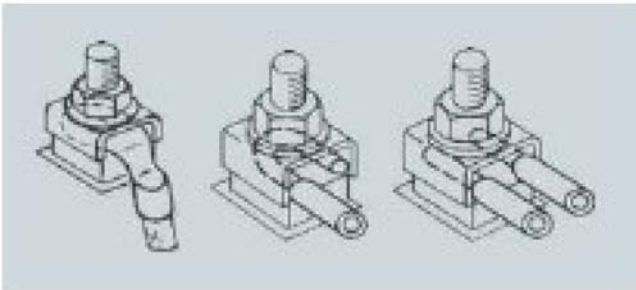
All work must be carried out by skilled worker.
 Before starting any work, be sure to isolate the machine from the main and auxiliary power supply as applicable.
 Mains must be secured against accidental switch on.

There are six power terminals and one earthing terminal located in the terminal box for FS80 to FS355. For FS315 and FS355, there is an additional earthing point located on the base of the frame. All motors are suitable for bi - directional rotation (CW or CCW). Phase change can be achieved by interchanging any two phases.

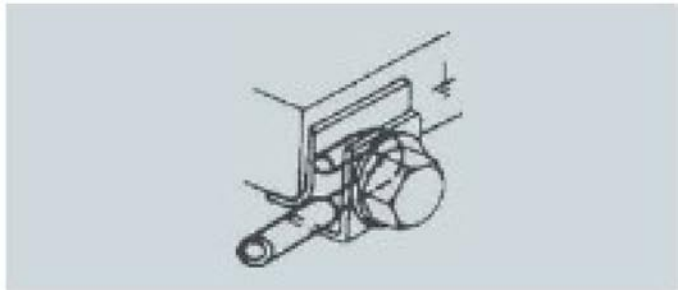
Mains Power Connection

Windings of standard three-phase single speed motors can be connected either in star or delta connection. Voltage and frequency deviations of $\pm 5\%$ Vac and $\pm 2\%$ Hz respectively of the rated voltage and frequency values are acceptable for proper operation.

Cable Connection Examples



FS315 & FS355 External Earthing



Please refer to Table 1 for tightening torque and direction for electrical terminal lugs.



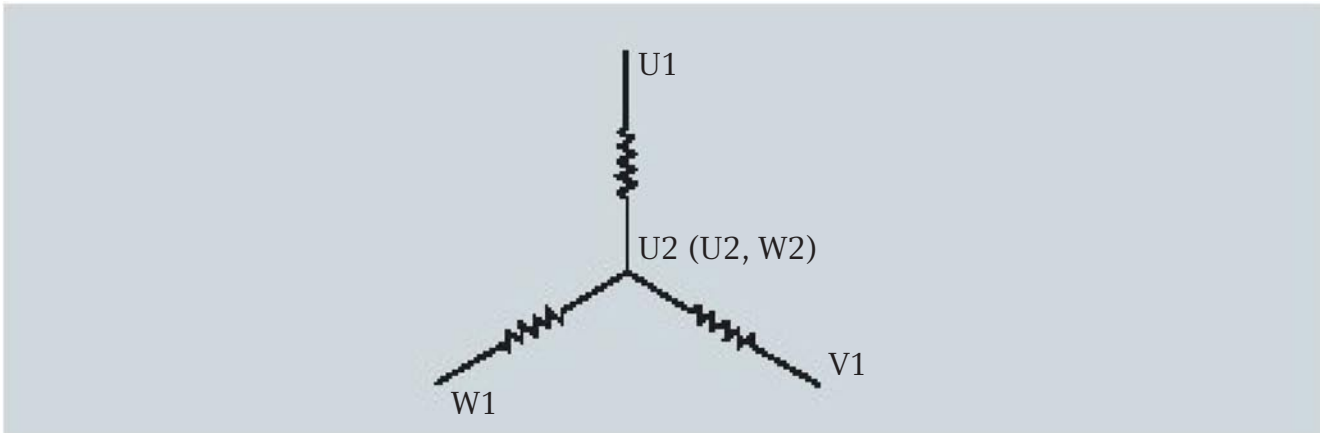
Table 1

Size	M4	M5	M6	M8	M10	M12	M16
Torque (Nm)	1.2	2.5	4.0	8.0	13	20	40

Note: Tightening Torque (Nm, Tolerance: $\pm 10\%$)

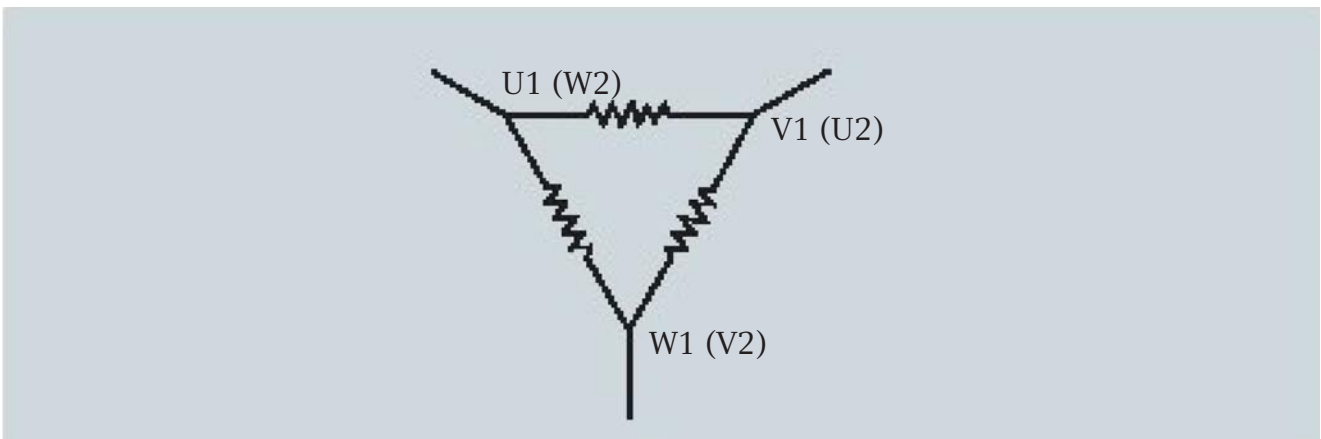
Star connection

A star connection is obtained by connecting W2, U2, V2 terminals to each other and the U1, V1, W1 terminals to the mains.



Delta connection

A delta connection is obtained by connecting the end of a phase to the beginning of the next phase.



Note: If the auxiliary or mains cable entries on the terminal box is sealed with gland plugs, a flat (standard) screw driver is required for removal.

Winding Protection

1LG0 motors have two types of electrical protection available as an option:

- PTC - used for temperature alarming or tripping function
- PT100 - used for monitoring temperature of bearing or stator windings.

Notice! Both the PTC and PT100 require connection to an external control unit.

Warning! When PT100s are used for bearing temperature monitoring, the alarming and tripping values are independent of those of the winding class.

Aux terminal Connection

If the motors are configured with the options A11, A12, A60, A61, A72 or K45, the auxiliary terminal connection is shown in Table 2.

Table 2

A11		A12				A60						A61						A72				K45							
PTC		PTC		PTC		U		V				W				Thermometers for rolling-contact bearings				Heater									
								U1		U2		V1		V2		W1		W2		DE		NDE							
C1	C2	C1	C2	C3	C4	T1	T2	T3	T4	T5	T6	T1	T2	T7	T8	T3	T4	T9	T10	T5	T6	T11	T12	T13	T14	T15	T16	P1	P2
						T1	T2	T3	T4	T5	T6	T1	T2	T7	T8	T3	T4	T9	T10	T5	T6	T11	T12	T13	T14	T15	T16		

Note: for A12 option, terminal C1 and C2 are used for tripping, C3 and C4 are used for alarming.

Motors which are exposed to a wide temperature fluctuation during standstill are susceptible to condensation formation, hence it is strongly recommended that a space heater (Option code: K45) be added.

Warning! The space heater must never be energised during motor operation.

3.5 Insulation resistance inspection

After extended periods of storage or standstill (6 months or longer), it is recommended to measure the insulation resistance between phases and phase to ground prior to applying power at start-up.

Warning! During and shortly after the resistance measurement, the motor terminals are hazardous with a residual voltage charge. Avoid touching the terminals.

Insulation resistance

The minimum insulation resistance between new, cleaned or repaired windings with reference to ground is 10MΩ.

The critical insulation resistance (Recruit) is calculated by multiplying the rated voltage, e.g. 0.69kV_{ac}, with the constant factor (0.5MΩ / kV):

$$\text{Recruit} = 0.69\text{kV} * 0.5\text{M}\Omega / \text{kV} = 0.345\text{M}\Omega$$

Measurement

The minimum insulation resistance between the windings and ground measurement is taken at 500V_{dc} and at a winding temperature of 25°C ± 15°C.

The measurement of the critical insulation resistance: it should be measured with 500V DC with the winding at operating temperature.

Normal failure and corrective measures on insulation resistance

Cause: Might be due to high humidity.

Correction: Windings must be dried.

Cause: After extended periods of operation, the minimum insulation resistance may decrease. However as long as the measured value is not less than the Recruit values the motor will continue to operate.

Correction: If the measured value is less than the Recruit value then the motor must be replaced or repaired.

3.6 Drive Application



In applications when motor torque is variable (piston-type compressor, load for example), the inevitable result is a non-sinusoidal motor current, whose harmonics can lead to excessive system perturbation or excessive electromagnetic interference.

Electromagnetic compatibility

In application where the motor is driven by a drive, the degree of electrical interference depends on the type of drive used (type, number of IGBTs, interference suppression measures, and manufacturer), cabling, distance and application requirements.

The installation guidelines of the drive manufacturer with regards to electromagnetic compatibility must be considered at all times during the design and implementation phases.



If the motor is driven by a drive and the, operating speed exceeds synchronous speed then considerations must be give to the mechanical components and transmission coupling.
Please refer to IEC 60034-1 for further details.

Noise, Temperature and Vibration

When motor are used with converter fed operation, the noise and temperature rise will be a little worse than standard motor with rated speed.

Due to increased speeds above the rated speed, vibration of motor will increase. Therefore, the mechanical smooth running is changed, and lifetime of grease and bearing will be reduced.

4.0 MAINTAINCE



Before starting any service and maintenance work on the motor the motor must be properly isolated from the mains and auxiliary power.

The usual "5 safety rules" (as set forth in DIN VDE 0105) are:

- Isolate the equipment
- Take effective measures to prevent reconnection
- Verify equipment is dead
- Ensure Earthing correctly
- Cover or fence off adjacent live parts

These precautions listed above should remain in force until all maintenance work is finished and the motor has been fully assembled.

4.1 Bearing lifetime

The average bearing lifetime for motors with sealed or open bearing at the DE & NDE varies between 20,000 and 40,000 hours for horizontal mounted motors without additional axial loading. This 20,000 or 40,000 hours of operation applies to 2, 4, 6 pole motors when operated at an ambient 40°C based on rating plate data. For every 10K temperature rise above 40°C, the grease lifetime is reduced by one half.

Notice! Extended storage periods, excessive vibrations and high humidity levels will reduce the useful life of the DE & NDE bearing and bearing grease. For sealed or regreasable bearing, it is recommended that permanently lubricated bearings should be replaced after 24 months of storage. If the motor is equipped with regreasable DE & NDE bearing, the grease must be replaced as per the published time intervals in section 4.2.

Warning!

Operating a motor above synchronous speeds for extended periods of time will reduce the bearing grease lifetime.

4.2 Grease type

Type of grease: UNIREX N3 (Esso); Conforms to DIN 51825-K3N.

Motors equipped with a regreasing device (K40 option) will have the grease information stamped on the rating plate or a sticker on the fan cowling.

4.3 Grease lifetime and regreasing intervals

During the bearing lifetime, the grease need not to be changed for the motor with frame size "80~160".

When the motor with frame size "180~280" runs under rated voltage and frequency in normal environment, the grease need not to be changed during the bearing lifetime. When motor runs under very harsh environment, where grease life is significantly shortened, re-greasing device (option code: K40) is recommended to be selected for convenient grease change. Please refer to the re-greasing intervals in Table 3.

The standard motor with frame size "315~355" is equipped with re-greasing device. Please refer to re-greasing intervals in Table 3.

Table 3

Number of Poles	Frame Size	Operation Duration	Permanent lubrication (No re-greasing)	Regreasable
2, 4, 6	FS80-FS280	20,000 , or 40,000 1) hrs	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	FS315	3,000hrs	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4, 6	FS315	5,000hrs		<input checked="" type="checkbox"/>
2	FS355	2,000hrs		<input checked="" type="checkbox"/>
4, 6	FS355	4,000hrs		<input checked="" type="checkbox"/>

Note: Regreasing of 2, 4, 6 poles motors from FS180 ~ FS280 is only possible when the K40 option is selected.

Exception! In applications where the motor is installed vertically or operating with heavy vibration, sudden load changes, frequent reversing operation, etc., the grease should be changed at considerably more frequent intervals than the operating hours stated above.

4.4 Regreasing procedure

Warning! All local safety regulations must be considered when regreasing the motor in operation or at a standstill.



Care must be taken not to over grease the bearings as this can result in increased bearing temperatures.
Dust and old grease must be prevented from entering the motor bearings during the regreasing cycles.

Notice! The regreasing nipple should be cleaned of old grease and dust prior to attaching the regreasing device.

It is recommended that the DE and NDE bearings should be regreased while the motor is in operating and at operating temperature.

If it is not possible to regrease the motor during operation, then it is recommended that a partial amount of the grease is injected and then the motor energised and rotated for a few revolutions to allow for grease dispersion. After coming to a complete stop the remaining grease should be added.

If a DE or NDE bearing have experienced overheating, it is recommended that the bearing should be inspected for heat damage and replaced or regreased as necessary.

Notice! Bearing grease will appear dark in colour if overheating was experienced.

4.5 Bearing replacement – assembly and disassembly

As bearings near the end of their useful lifespan, the vibration and noise levels of the motor will increase considerably.

If bearing inner diameter or wear clearance is out of specification as per table 4, the bearing must be replaced.

Table 4

Frame Size (mm)	80 ~112	132 ~ 160	180 ~ 250	280 ~ 355
Bearing inner dia (mm)	20 ~ 30	35 ~ 50	55 ~ 80	85 ~120
Wear clearance (mm)	0.1	0.15	0.2	0.3

Notice! Worn or damaged bearings must be replaced with an equivalent bearing matching the original specifications.

When replacing the bearing, dismantle the necessary parts and use a suitable bearing extraction tool to remove the damaged or worn bearing.

Before installing the new bearing, pre-heat the bearing as per the manufacture instruction prior to pressing it onto the rotor shaft. Shaft sealing rings (V Ring or Oil Seal) must be replaced with new ones after bearing replacement.

Warning! Any impacts or hits (such as with a hammer etc.) is strictly forbidden as this will damage the bearing and result in premature failure.

Please refer to tightening torques for the end flange bolts.

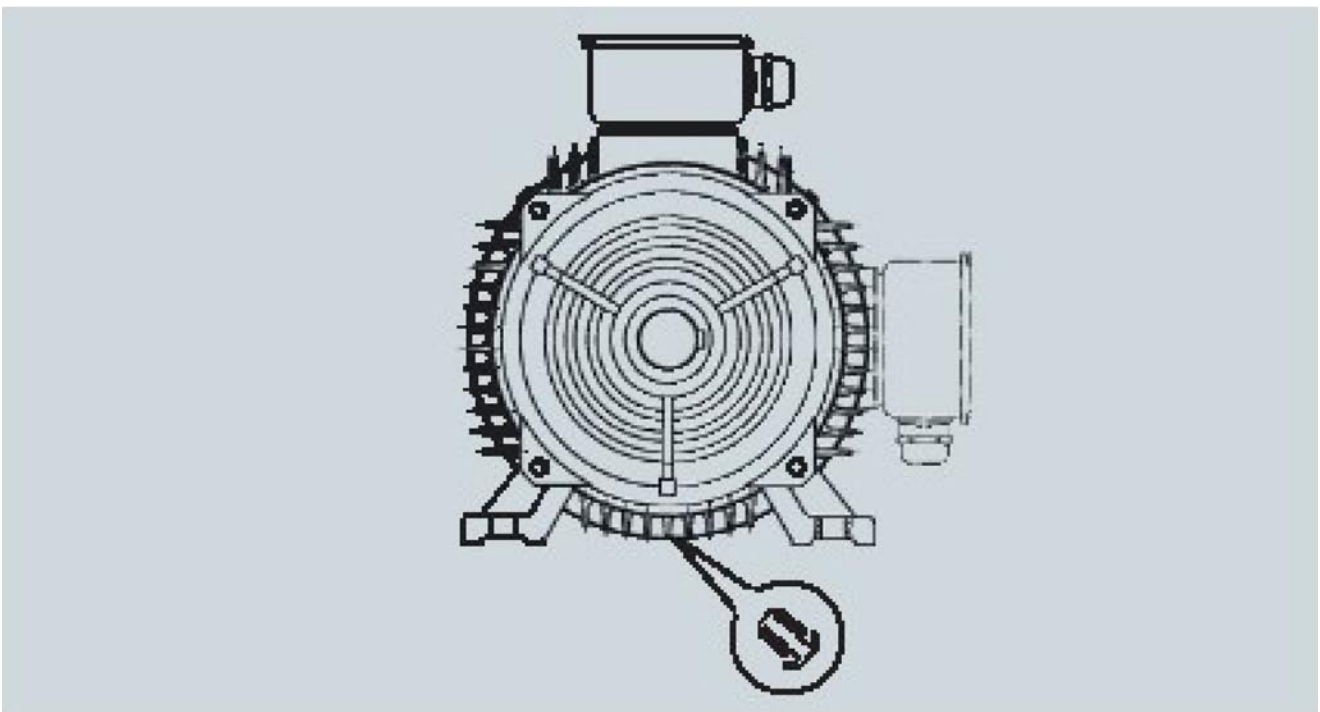
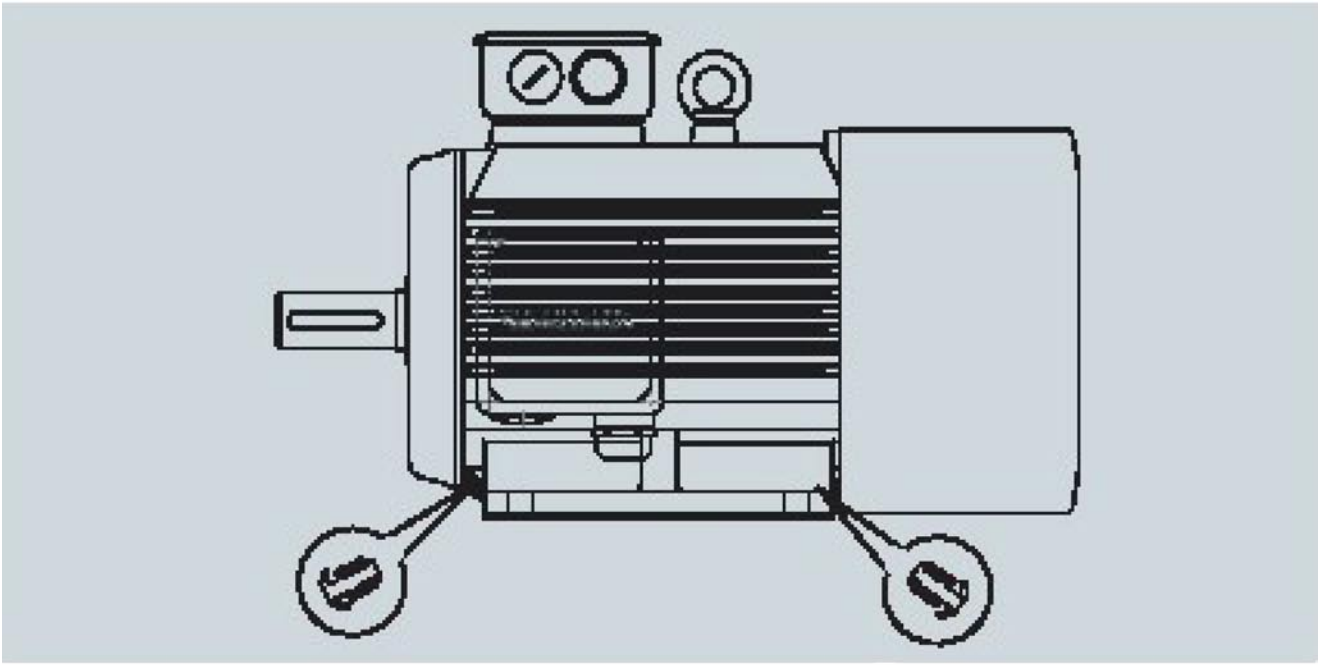


Size	M4	M5	M6	M8	M10	M12	M16	M20
Torque (Nm)	2	3.5	6	16	28	46	110	225

Note: Tightening Torque (Nm, Tolerance: $\pm 10\%$)

4.6 Condensation drain plug

The condensation drain holes are located on the frame of motor with frame size 160mm and above as standard. And the motors with condensation drain holes are delivered from factory with pre-installed plastic plugs. Please refer to the location of condensation drain hole shown in the following pictures.



5.0 START UP

Preliminary Inspection

Before applying power to the motor for the first time, it is recommended to check:

- 1) All retaining bolts are tightened including transmission coupling and alignment
- 2) Motor cooling fan unobstructed
- 3) Adequate bearing lubrication (grease) if equipped with regreasing nipples
- 4) Mains supply voltage and connection method match those of the rating nameplate for operation on DOL, Soft start, Drive
- 5) Proper connection of earthing (grounding) terminal
- 6) Terminal connection correctness for thermal sensor and space heater if equipped

After power is applied to the motor, be sure to check motor for correct direction of rotation, air flow, current draw and any signs of excessive vibrations and noise levels.

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訂購編號：E86060-K5581-A111-A2-8C00

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