Ex

安全手册
防爆低压电机

SAFETY MANUAL
Low voltage Motors for explosive atmospheres

防爆低压电机

安全手册

目录

1.简介

注意！
为确保安全、正确地安装、操作和维护电机，请务必遵守以下各项说明。安装、操作、维护电机或相关设备的人员应认真了解这些说明。忽视这些说明可能导致所有适用的质保失效。

警告
防爆电机采用特殊设计，符合关于爆炸风险的正式法规。如果使用不当、连接错误或以任何方式改动（无论多么小的改动），此类电机的可靠性可能会受损。

必须考虑在危险区域中连接和使用电气设备的相关标准，特别是电机使用国的国家安装标准。只有受过培训且熟悉这些标准的人员才能处理这类设备。

1.1 符合性声明

符合指令 2014/34/EU (ATEX) 的声明见附录。

当电机安装到机器上时，调试方必须确保最终产品符合指令 2006/42/EC（机械）。

符合 CEL007《三相异步电动机能源效 率标识 实施规则》范围的产品，已在中国能 效标识网上备案，并按该规则在电机本体上 标贴相应的能效标识，能效标识样式按该规 则要求，能效等级及能效检测方法按 GB18613 要求，消费者可登陆中国能效标识 网www.energylabel.com.cn 查看详细备案信息。

1.2 有效性

这些说明适用于以下用于易爆环境的 ABB 电机类型。

增安型 Ex ec/Ex nA
M2A*/M3A* 系列
M3B*/M3G* 系列

增安型 Ex e、Exeb
M3H* 系列

隔爆型 Ex d、Ex de、Ex db、Ex db eb
M3KP/M3JP/IE4 M3JP系列

粉尘防爆型Ex t (Ex tD)
M2A*/M3A*/M3JP/IE4 M3JP系列
M2B*/M3B*/M3D*/M3G* 系列

（为了确定某种类型电机是否适合特殊应用或是否可进行特殊设计变更，ABB 可能需要更多信息。）这些说明适用于 –20°C 至 +50°C 环境温度下安装和存放的电机。注意：特定电机的温度范围包含以上整个温度范围。对于环境温度超出以上限值的情形，请联系 ABB。

1.3 符合性

除了符合机械和电气特性的相关标准，根据防护类型不同，设计用于易爆环境的电机还必须符合以下一项或多项欧洲或 IEC 标准：

产品标准

IEC/EN 60079-0、GB/T 3836.1 设备 - 一般要求
IEC/EN 60079-1、GB/T 3836.2 设备防护 - 隔爆外壳型 "d"
IEC/EN 60079-7、GB/T 3836.3 设备防护 - 增强安全型 "e"
IEC/EN 60079-15、GB/T 3836.8 设备防护 - 防护类型 "n"
IEC/EN 60079-31、GB/T 3836.31 设备防粉尘点燃外壳 "t"
IEC 60050-426、GB/T 2900.35 易爆环境用设备

安装标准

IEC/EN 60079-14、GB/T 3836.15 电气装置设计、选择和安装
IEC/EN 60079-17、GB/T 3836.16 电气装置检查和维护
IEC/EN 60079-19、GB/T 3836.13 设备维修、彻底检修和改造
IEC 60050-426 、GB/T 2900.35 易爆环境用设备
IEC/EN 60079-10、GB/T 3836.14 危险区域分类（气体区域）
IEC 60079-10-1、GB/T 3836.14 区域分类 – 易爆性气体环境
IEC 60079-10-2、GB/T 3836.14 区域分类 – 可燃粉尘环境
EN 1127-1, -2 防爆与保护

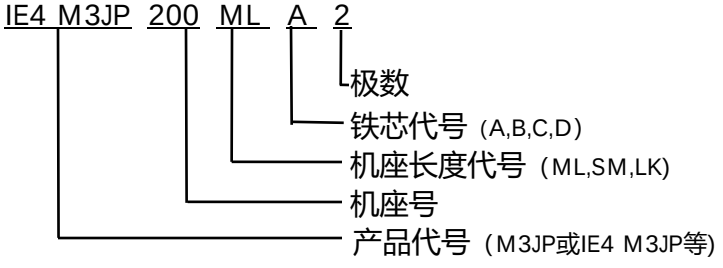
ABB 低压电机（对指令 94/9/EC 或 2014/34/EU 的 I、II 和 III 组有效）可安装在与以下标记相对应的区域：

区域	设备防护等级 (EPL)	种类	防护类型
1	'Gb'	2G	Ex db/Ex db eb
2	'Gb' 或 'Gc'	2G 或 3G	Ex db/Ex db eb/ec
21	'Db'	2D	Ex t
22	'Db' 或 'Dc'	2D 或 3D	Ex t
–	'Mb'	M2	Ex db/Ex db eb

环境：
G – 气体导致的易爆环境
D – 可燃粉尘导致的易爆环境
M – 容易产生矿井瓦斯的矿井

1.4 产品型号

示例：



2.安全事项

电机应由熟悉健康和安全要求及国家法规的合格人员安装和使用。

必须根据当地规定提供必要的安全设备，以防安装和操作现场发生事故。

警告！
紧急停机控制装置必须配有重启锁。紧急停机后，必须特意复位重启锁，才能使重新启动命令生效。

需要注意的事项

1.不要踏在电机上。
2.正常工作过程中，尤其是在停机后，电机外壳温度可能很高，不能触摸。
3.部分特种电机应用可能需要其他的指导书（例如随变频器一起提供时）。
4.注意电机的旋转部件。
5.不得打开已通电的接线盒。

注意！
与安全使用相关的其他警告和/或注意事项请参阅本手册的其他章节。

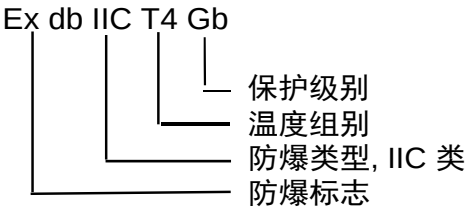
2.1 IIC 和 III 组中的电机

对于根据 IEC/EN60079-0或 GB/T 3836.1 认证的组 IIC和组 III 电机：

警告！
为了最大程度地降低静电引起的危险，只能用湿布或通过非摩擦性方式清洁电机。

2.2 防爆标志

Ex db IIB/IIC T4 Gb
Ex tb IIIB/IIIC T130℃/T135℃ Db
Ex tc IIIB/IIIC T130℃/T135℃ Dc



2.3防爆证书

国际证书号：

IE3 M3JP80-132: CNEX 21 ATEX 0002X
IECEx CNEX 21.0003X
IE3 M3JP160-355: CNEX 18 ATEX 0032X
IECEx CNEX 18.0041X
IE4 M3JP160-355: IECEx CNEX 23.0004X

2.4 特定使用条件

2.4.1 机座号80-132

对IC 411冷却方式电机，环境温度范围限于-20°C... +60°C。

对IC416冷却方式电机，环境温度范围限制在-20℃ ... +40℃。

某些隔爆接合面的尺寸低于IEC/EN 60079-1的表2和表3中定义的最大值。这些制造间隙在制造商拆卸和组装指南N°3GZF500708-104中定义。

对于VSD运行以及对于S1以外的工作制类型，应通过定子绕组中的电阻温度计或PTC热敏电阻来监视电机温度。这些设备必须连接到经过功能测试的断路开关上。

对于VSD运行，必须遵守制造商对变频供电源的说明。最小开关频率为3 kHz。

必须严格遵守制造商的指示，以最大程度地减少静电释放的风险。

隔爆外壳的特殊紧固件的最低质量等级应为8.8（对于碳素钢螺钉）和A4-80（对于不锈钢螺钉）。

2.4.2 机座号160-355

对IC 411冷却方式电机，环境温度范围限于-20°C... +50°C。

对于IC416冷却方式的VSD运行（5-100Hz）电机，环境温度范围限制在-20℃...+40℃。

外壳和衬套中隔爆接合面长度大于IEC 60079-1标准中规定的最小值。如果需要，必须按照制造商提供的结构规范对隔爆面进行维修。螺纹隔爆面的维修必须符合制造商提供的规范。不得仅根据IEC 60079-1:2014表4中规定的值进行维修。

对于VSD运行和S1以外的工作类型，应通过定子绕组中的电阻温度计或PTC热敏电阻监测电机温度。这些装置必须连接到经过功能测试的跳闸装置。

对于VSD运行，必须遵守制造商关于变频器供电机器的 说明。以下VSD操作必须遵守以下参数：

-开关频率：≥3 kHz（PWM）
-开关频率：≥ 2 kHz（DTC）
-最大峰值电压：1300 V（标准绝缘），1800 V（特殊绝缘）

所有电气连接均应按照制造商说明中规定的拧紧扭矩拧紧。

当在690 V–60 Hz下运行时，以下4种型号环温：

—M3JP180MLA4（18.5kW）和M3JP225SMA4（37kW）：-20°C...+45°C
—M3JP225SMB4（45kW）和M3JP315SMC6（75kW）：-20°C...+40°C。

2.5 机座最大功率

机座号	80	90	100	112	132	160	180	200	225	250	280	315	355
最大功率[kW]	1.1	2.2	3	4	7.5	18.5	22	37	45	55	90	250	355

3.处理

3.1 收货检查

收到货后，请立即检查电机外部（例如轴端、法兰和喷漆表面）有无损坏，若有，请立刻通知运输商。

检查所有铭牌数据，特别是电压、绕组接线（星形或三角形）、种类、防护类型和温度类别。除最小机座规格的电机外，所有其他电机的铭牌上都指定了轴承类型。

对于变速驱动应用，根据电机第二铭牌上给出的频率检查允许的最大负载。

3.2 运输和存放

电机务必存放在室内（高于 –20°C）、干燥、无振动、无尘的条件下。运输期间，应避免撞击、坠落和受潮。其他情况下，请联系 ABB。

对无保护的机加工表面（轴端和法兰）应进行防锈处理。

建议定期用手转动电机轴，防止润滑油迁移。

若装有抗冷凝加热器，建议为其通电以避免电机内出现冷凝。

电机在静止时不得经受任何超过 0.5 mm/s 的外部振动，以免损坏轴承。

装有滚柱和/或角接触轴承的电机，在运输过程中必须装上锁止装置。

3.3 起吊

所有重量超过 25 kg 的电机都配有吊耳或吊环螺栓。

只能用电机的主吊耳或吊环螺栓吊起电机。如果电机固定在其他设备上，则不得使用这些附件吊起电机。

不得使用辅助设备（例如制动器、独立冷却风扇）或接线盒的吊耳来吊起电机。

由于法兰长度、安装方式和辅助设备不同，相同机座的电机可能有不同的重心。

不得使用损坏的吊耳。起吊前，应检查吊环螺栓或做成一体的吊耳是否完好无损。

起吊前，必须对吊环螺栓进行紧固。如有必要，可以使用合适的垫片调整吊环螺栓的位置。

确保使用正确的起重设备，并且吊钩尺寸与吊耳匹配。

注意不要损坏连接至电机的辅助设备和电缆。

移除将电机固定到托盘的运输夹具。

具体起吊说明可从 ABB 获得。

警告！
在起吊、安装和维护过程中，所有必要的安全措施都必须就位且必须特别小心，以确保不会有人可能因为起吊的重物受伤。

3.4 电机重量

由于输出功率、安装方式和辅助设备不同，相同机座规格（中心高度）的电机总重量可能不同。

下表列出了不同机座材料的基本型号电机的估计最大重量。

所有 ABB 电机的实际重量都在铭牌上标示。

机座大小	**铝** 最大重量 (kg)	**铸铁** 最大重量 (kg)	**隔爆型** 最大重量 (kg)
71	7	12	-
80	15	31	40
90	20	44	53
100	31	63	72
112	35	72	81
132	93	120	120
160	145	260	260
180	180	310	310
200	250	340	350
225	320	430	450
250	390	530	510
280	430	900	850
315	-	1600	1300
355	-	2600	3000
400	-	3500	3700
450	-	4800	5000

如果电机配有制动器和/或独立风扇，请联系 ABB 以获得其重量信息。

4. 安装与调试

警告
在电机或从动设备上工作之前，请断开电源并上锁。执行绝缘电阻检查程序时，须确保不存在爆燃性气体或粉尘。

警告
电机使用时，需将塑料堵头更换为具有防爆认证的电缆引入装置!

4.1 通用事项

必须仔细检查所有与认证相关的铭牌数据，确保电机防护、环境和区域兼容。

必须特别注意粉尘点燃温度和粉尘层厚与电机温度标记的关系。

电机 需要护顶的电机：
当垂直安装且电机轴指向下方时，电机必须有保护罩，以防外物和液体落入通风口。另外也可以使用一个未固定到电机的独立盖子进行防护。这种情况下，电机必须有一个警告标签。

4.2 采用非球轴承的电机

若有运输锁止装置，应将其移除。如果可能，用手转动电机轴，检查能否自由旋转。

配有滚柱轴承的电机：
由于“滑动”效应，在无径向力作用于电机轴的情况下运转电机可能会损坏滚柱轴承。

配有角接触轴承的电机：
在无正确方向轴向力作用于电机轴的情况下运转电机可能会损坏角接触轴承。

警告
对于配有角接触轴承的 Ex d/Ex db 和 Ex de/ Ex db eb 电机， 无论如何都不得改变轴向力的方向，否则电机 轴周围的隔爆间隙会发生改变，甚至可能引起接触！

铭牌上指明了轴承类型。

配有润滑油嘴的电机：
首次启动电机或长期存放后启动电机时，请注入指定量的润滑油。

有关详细信息，请参阅“7.2.2 带润滑油嘴的电机”部分。

4.3 绝缘电阻检查

调试之前以及怀疑绕组受潮时，应测量绝缘电阻。

绝缘电阻（校正到 25°C）在任何情况下都不得低于 1 MΩ（采用 500 或 1000 VDC 测量）。温度每上升 20°C，绝缘电阻值即减半。

图 1 可用于所需温度下的绝缘校正。

警告
为了避免触电风险，电机机座必须接地，在每次测量后，必须立即将绕组在机座上放电。

如果未达到参考电阻值，则说明绕组已经受潮，必须在烘箱内将其烘干。在 90°C 烘箱温度下烘 12-16 小时，再在 105°C 下烘 6-8 小时。

烘干时，必须拔除排水孔塞并打开隔断阀。烘干后再装上排水孔塞。即便装有排水塞，仍建议在烘干过程中拆除端罩和接线盒盖。

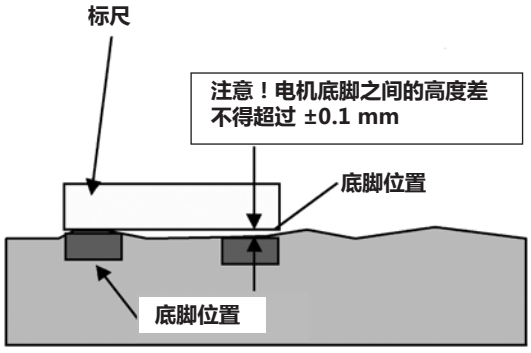
被海水浸湿的绕组一般需要重绕。

4.4 地基

地基准备工作全部由最终用户负责。

金属地基应涂漆，以防腐蚀。

地基必须平整且坚固，足以承受短路产生的冲击力。地基的设计和尺寸必须避免振动传递到电机以及共振引起振动。参见下图。



4.5 半联轴器和皮带轮的平衡与安装

平衡电机的标准方法是使用半键。

半联轴器或皮带轮必须在对键槽进行加工后平衡。必须按照电机指定的平衡方法调节平衡。

必须用合适的设备和工具将半联轴器和皮带轮安装到轴上，避免损坏轴承和密封件。

切勿将半联轴器或皮带轮锤击入位，也不要用杠杆抵住电机体拆下它们。

4.6 电机的安装和校准

确保电机周围有足够的空间以便空气自由流通。建议在风机外罩与墙面等之间留出至少 ½ 风机外罩进气口大小的间距。更多信息请参阅产品目录或网站 (www.abb.com/motors&generators) 上的尺寸图。

是否正确对准是避免轴承故障、振动和可能轴故障的关键所在。

使用合适的螺栓或螺柱将电机安装在地基上，并在地基与底脚之间放置薄垫板。

用合适的方法校准电机。

如使用，钻定位孔，然后将定位销固定就位。

半联轴器的安装精度：检查间隙 b，确保其小于 0.05 mm，**a1** 和 **a2** 之间的间隙也应小于 0.05 mm。参见图 2。

最终紧固螺栓或螺柱之后，再检查一次对准情况。

不得超过产品目录中规定的轴承允许负载值。

检查电机内空气流通是否充分。确保电机不受附近设备热辐射或阳光直射的影响。

对于法兰安装型电机（例如 B5、B35、VI)，确保其结构允许法兰外表面有充分的空气流通。

4.7 径向力和皮带传动

皮带必须根据传动设备制造商的说明张紧。然而，皮带张力（即径向轴承负载）不得超过相关产品目录中规定的最大值。

警告
皮带过紧会损坏轴承，并有可能引起电机轴断裂。对于 Ex d/Ex db 和 Ex de/Ex db eb 电机，皮带过紧甚至可 能令火焰通路部件最终相互接触，造成危险。

4.8 带有冷凝排水塞的电机

检查排水孔和排水塞是否朝下。在垂直安装的电机中，排水赛可能处于水平位置。

无火花型和增安型电机
带有可密封塑料排水塞的电机在交付时，铝质电机的排水塞处于关闭位置，铸铁电机的排水塞处于打开位置。在干净的环境中，操作电机之前应打开排水塞。在灰尘过多的环境中，应关闭所有排水孔。

隔爆型电机
排水塞（若要求配备）位于端罩的下部，以便冷凝水可从电机流出。逆时针转动以打开排水塞，轻轻敲击，检查能否正常工作；按住并顺时针转动可关闭排水塞。

粉尘防爆型电机
所有粉尘防爆型电机的排水孔都必须关闭。

4.9 电缆敷设和电气接线

标准单速电机上的接线盒通常包含六个绕组接线端子和至少一个接地端子。

除主绕组和接地端子外，接线盒还可能包含用于热敏电阻、加热元件或其他辅助设备的接头。

连接所有主电缆时，必须使用合适的电缆接线头。辅助设备的线路可连接至接线端子。

电机只能固定安装。如无特别说明，电缆入口采用公制螺纹。电缆引入装置的保护类型和 IP 等级至少必须与接线盒相同。

对于增安型和隔爆型电机，只能使用获得相应 认证的电缆密封管引入装置。对于无火花型电机，电缆引入装置必须符合 IEC/EN 60079-0 标准。对于 Ex tD/Ex 电机，电缆引入装置必须符合 IEC/EN 60079-0 和 IEC/EN 60079-31 标准。

注意！
电缆在靠近接线盒的地方应采用机械防护并夹住，以便满足 IEC/EN 60079-0 的相关要求和当地安装标准。

未使用的电缆入口必须根据接线盒的保护类型和 IP 等级用封堵件密封。

保护类型和直径在电缆密封盒相关的文档中指明。

警告
根据防护等级以及电缆的型号和直径，在电缆入口中使用适当的电缆密封管和密封件。

将电机连接至电源之前，必须按照当地规定进行接地。

机座上的接地端子必须用一条电缆连接至 PE（保护接地），如 IEC/EN 60034-1 的表 5 所示：

保护导体的最小截面积

导线每相截面积，S，mm^2	对应保护接地导体最小截面积 S_p，mm^2
4	4
6	6
10	10
16	16
25	25
35	25
50	25
70	35
95	50
120	70
150	70
185	95
240	120
300	150
400	185

此外，电气设备外部的接地必须提供截面积至少为 4 mm^2 的有效导体连接。

根据铭牌上给出的额定电流，电源与电机端子之间的电缆连接必须满足国家标准关于安装的要求，或 IEC/EN 60204-1 标准规定的要求。

注意！
– 机座号小于225的电机，至少应使用允许工作温度为 +90°C 的电缆。
– 对机座号225及以上的电机，应使用允许工作温度不低于 +110°C 的电缆。
– 在选择电缆规格时，应该考虑所有其他取决于安装条件的转换因素。

确保电机保护类型与环境和气候条件相适应。

必须将接线盒（非 Ex d/Exdb）的密封件正确放置在所提 供的槽中，确保 IP 等级无误。泄漏可能导致灰尘或 水渗入，引发带电元件飞弧的风险。如果更换了密 封件或垫圈，必须使用原配密封解决方案的材料。

4.9.1 隔爆型电机

接线盒保护类型：

– M3JP和 IE4 M3JP 电机是Ex db

为使接线盒的自由空间量最大，请使用隔爆电缆引入装置。下表列出了不同规格电机的自由空间体积以及引入装置螺纹的数量和类型。

电机类型 **M3JP / IE4 M3JP**	极数	接线盒型号	螺纹孔	接线盒自由体积	盖板螺栓大小	接线盒螺栓的紧固扭矩
80 – 90	2 – 8	25	1xM25	1.0 dm^3	M8	23 Nm
100 – 132	2 – 8	25	2xM32	1.0 dm^3	M8	23 Nm
160 – 180	2 – 8	63	2xM40	4.0 dm^3	M10	46 Nm
200 – 250	2 – 8	160	2xM50	10.5 dm^3	M10	46 Nm
280	2 – 8	210	2xM63	24 dm^3	M8	23 Nm
315	2 – 8	370	2xM75	24 dm^3	M8	23 Nm
355	2 – 8	750	2xM75	79 dm^3	M12	80 Nm
400 – 450	2 – 8	750	2xM75	79 dm^3	M12	80 Nm

辅助电缆入口

电机类型	极数	螺纹孔
80 – 132	2 – 8	1xM20
160 – 450	2 – 8	2xM20

合上接线盒盖时，确保表面间隙上没有积灰。用非硬化接触式润滑脂清洁并润滑表面。

警告
在易爆环境下，当电机仍然较热且通电时，请勿打开电机或接线盒。

4.9.2 粉尘防爆型电机 Ex t

标准配置是电机的接线盒固定在顶部，电缆可从两侧接入。详细说明参见产品目录。

应特别注意接线盒和电缆的密封，防止可燃粉尘进入接线盒。必须检查外部密封是否完好无损且妥善就位，因为它在搬运过程中可能会被损坏或移动。

合上接线盒盖时，确保表面间隙上没有积灰，并检查密封是否完好无损，若不然，必须换上相同的密封件。

警告
在易爆环境下，当电机仍然较热且通电时，请勿打开电机或接线盒。

4.9.3 不同启动方法的接线

标准单速电机上的接线盒通常包含六个绕组接线端子和至少一个单独的接地端子。这允许使用 DOL 或 Y/D 启动。参见图 3。

对于双速电机和特殊电机，端子接线必须依照接线盒内部或电机手册中的说明进行。

铭牌上印有电压和接线说明。

直接启动 (DOL)：
可以采用 Y 或 D 绕组连接。

例如，690 VY、400 VD 表示 690 V 的 Y 接线和 400 V 的 D 接线。

星形/三角形（Y形/三角形）启动 (Y/D)：
在使用 D 接线时，电机的电源电压必须等于额定电压。

拆除接线板中的所有接线片。
对于增安型电机 (Ex e/Ex eb)，直接启动和星形-三角 形启动均可。如果是星形-三角形启动，只能使用防 爆认证的设备。

其他启动方法和恶劣启动条件：
如果在 S1 和 S2 工作类型中使用其他启动方法（例如变频器或软启动器），可认为该设备在电动机运行时与电力系统隔离”，如 标准IEC 60079-0 所示，并且热保护可选。

4.9.4 辅助设备接线

如果电机配有热敏电阻或其他 RTD（Pt100、热敏继电器等）以及辅助设备，建议通过合适的方法连接和使用它们。某些应用必须采用热保护。详细信息可在随电机提供的文件中找到。辅助元件和连接部件的接线图可在接线盒内找到。

热敏电阻的最大测量电压为 2.5 V。Pt100 的最大测量电流为 5 mA。使用更高的测量电压或电流可能会引起读数误差或损坏温度检测器。

热传感器的绝缘满足基本绝缘要求。

4.10 端子和旋转方向

当电源相序 - L1、L2、L3 - 如图 3 所示连接到端子时，面向电机驱动端看轴面，轴的旋转方向为顺时针方向。

若要更改旋转方向，可交换电源电缆上的任意两个接线位置。

如果电机装有单向风扇，请确保其旋转方向与电机上标记的箭头方向一致。

4.11 过载和失速保护

用于爆炸环境的所有电机都必须有过载保护，请参见安装标准 IEC/EN 60079-14 和当地安装要求。

对于增安型电机 (Ex e/Ex eb)，保护装置的最大跳闸时 间不得长于电机铭牌上给出的时间 t_E。

对于 Ex ec 和 Ex t 类型的电机，不要求正常工业保护之外的其他安全设备。

5.运行

5.1 通用事项

除非铭牌上特别指明，否则电机设计在下列条件下使用。

- 电机必须安装在固定装置上。
- 正常环境温度范围是 -20°C 至 +50°C。
- 最高海拔高度是 1000 m。
- 电源电压和频率的变化不得超过相关标准中提及的限值。按照图 4（EN / IEC 60034-1 第 7.3 条，A 区），电源电压的容差为 ±5 %，对频率为 ±2 %两者的极端值不应同时出现。

电机只能用于所设计用途的应用。电机铭牌上给出了额定标称值和工作条件。此外，必须遵守本手册和其它相关说明与标准中的所有要求。

如果超出这些限值，则必须检查电机数据和结构数据。更多信息请联系 ABB。

使用隔爆型电机时，必须特别注意腐蚀性环境。确保油漆防护与环境条件相适应，否则隔爆外壳可能因腐蚀而损坏。

警告！
忽视任何说明或设备维护，可能危及安全，从而导致机器不能在爆炸环境中使用。

6. 爆炸环境变速运行的电机

6.1 简介

手册的本部分提供爆炸环境中使用且采用变频器电源的电机（后面简称Ex电机）的附加说明。Ex 电机只能使用单个变频器电源，且单个变频 器上不能并行运行其他电机。除了本手册中的这些 规定外，还应遵循变频器厂商提供的其他规定。

ABB 生产的Ex电机：Ex ec、Ex t、Ex d/Ex db 和 Ex de/Ex db eb 已经配合采用 DTC 控制的 ACS800/ ACS880 和 ACS550 变频器进行了型号测试，因此可以使用第 6.8.2 节提供的选型说明来选择这些组合。所有类型Ex电机的最小开关频率为3 kHz，是后续章节选型 指导的基础。

6.2 EN 和 IEC 标准的主要要求

隔爆型电机 Ex d/Ex db、Ex de/Ex db eb
电机必须有合适的尺寸，使得其表面最高温度不超过温度组别的限制。多数情况下，这需要进行型号测试，或对电机表面温度进行控制。

如果对 Ex d/Ex db 或 Ex de/Ex db eb 电机要求温度组别T5 或 T6，请联系您的当地销售办事处寻求帮助。

对于其他采用脉宽调制型控制 (PWM) 的电压源变频器，通常需要通过组合测试来确认电机具有合适的热性能。如果隔爆型电机配有用于控制表面温度的热传感器，则无需进行测试。此类电机的铭牌上有如下附加标记：- "PTC" 和跳闸温度以及 "DIN 44081/82"。

增安型电机 Ex e/Ex eb
ABB不建议将低压散线绕组增安型电机与变速驱动器一起用。本手册不涉及变速驱动情况下的此类电机。

增安型电机 Ex nA/Ex ec
电机与变频器的组合必须作为一个单元进行测试，或通过计算选型。

对于最小开关频率为 3 kHz 或更高的其他电压源 PWM 变频器，可以使用本手册第 6.8.3 节提供的说明进行初步选型。最终数值必须通过组合测试进行验证。

粉尘防爆型电机 Ex t (Ex tD)
电机必须有合适的尺寸，使得其外表面最高温度不超过温度组别（例如 T125°C 或 T150°C）的限制。关于 125°C 以下温度类别的更多信息，请联系 ABB。

对于其他采用脉宽调制型控制 (PWM) 的电压源变频器，通常需要通过组合测试来确认电机具有合适的热性能。如果 Ex t 电机配有用于控制表面温度的热传感器，则无需进行测试。此类电机的铭牌上有如下附加标记：- "PTC" 和跳闸温度以及 "DIN 44081/82"。

对于最小开关频率为 3 kHz 或更高的电压源 PWM 变频器，可以使用第 6.8.3 节提供的说明进行初步选型。

6.3 绕组绝缘

6.3.1 相间电压

电机端子上允许的最大相间电压峰值与脉冲的上升时间有关，请参见图 5。

最高曲线 “ABB 特殊绝缘”（变量代码 405）适用于具有针对变频器电源的带有特别绕组绝缘的电机。

“ABB 标准绝缘”适用于本手册涵盖的所有其他电机。

6.3.2 相对地电压

电机端子所允许的相对地电压峰值为：

- 标准绝缘 1300 V 峰值
- 特殊绝缘 1800 V 峰值

6.3.3 所有其他变频器用绕组绝缘选择

绕组绝缘和滤波器可以根据下表选择：

变频器的标称电源电压 U_N	要求的绕组绝缘和滤波器
$U_N \leq 500$ V	ABB 标准绝缘
$U_N \leq 600$ V	ABB 标准绝缘 + dU/dt 滤波器 或 ABB 特殊绝缘（变量代码 405）
$U_N \leq 690$ V	ABB 特殊绝缘（变量代码 405） 和 变频器输出端的 dU/dt 滤波器

6.4 绕组的热保护

所有铸铁 ABB 防爆电机都配有 PTC 热敏电阻，以防绕组温度超过所用绝缘材料的热限值。所有情况下都建议连接热敏电阻。

注意！
如果铭牌上无特别说明，热敏电阻不会防止电机表面温度超过其温度类别（T4 或 T5 ）的限值。

ATEX 国家：
如果电机证书要求，则必须根据 ATEX 指令 94/9/EC 或 2014/34/EU 附录 II 第 1.5.1 项“健康与安全关键要求”，将热敏电阻连接到一个独立工作的热敏电阻电路继电器，它专门用来可靠地断开电机的电源。

非 ATEX 国家：
建议将热敏电阻连接到一个独立工作的热敏电阻电路继电器，它专门用来可靠地断开电机的电源。

注意！
根据当地安装规定，可能也可以将热敏电阻连接到热敏电阻继电器以外的设备，例如连接到变频器的控制输入端。

6.5 轴承电流

在所有变速应用中，为确保应用安全可靠，必须避免轴承有电压和电流。为此，必须使用绝缘轴承或轴承结构、共模滤波器以及合适的布线与接地方法（参见第 6.6 节）。

6.5.1 轴承电流的消除

对于变频器驱动的电机，必须使用下列方法避免有害的轴承电流：

机座	
250 及以下	无需任何措施
280 – 315	非驱动端采用绝缘轴承
355 – 450	非驱动端采用绝缘轴承 和 变频器侧采用共模滤波器

关于轴承绝缘的确切类型，参见电机的铭牌。未经 ABB 允许，不得更改轴承类型或绝缘方法。

6.6 电缆、接地和 EMC

为提供正确的接地以及确保满足现行的 EMC 要求，功率高于 30 kW 的电机必须使用屏蔽对称电缆和提供 360°连接的 EMC 密封管连接。对于较小的电机，强烈建议使用对称屏蔽电缆。按照密封管说明中所述，在所有电缆入口处进行 360°接地连接。将电缆屏蔽扭绞成束，然后连接至接线盒、变频器机柜等中的最近接地端子/母线。

注意！
所有端接点（例如电机、变频器、可能的安全开关等）都必须使用提供 360°连接的正确电缆密封管。

对于机座规格为 IEC 280 及以上的电机，需要在电机机座和从动设备之间提供额外的电位均衡，除非它们安装在同一钢制底座上。后一种情况下，应检查钢制底座提供的连接的高频导电性，例如通过测量部件之间的电位差。

有关变速驱动器接地和电缆敷设的更多信息，请参见手册“驱动系统的接地和电缆敷设”（编号：3AFY 61201998）。有关满足 EMC 要求的材料，请参见相应的变频器手册。

6.7 负荷与速度限制

6.7.1 通用事项

注意！
不得超出电机的最大转速，尽管给出了最高 100 Hz 的负载率曲线。

6.7.2 使用 DTC 控制的 ACS800/880 系列变频器的电机负载能力

图 6 、图 7和图8 所示的负载率曲线（或负载能力曲线）给出了电机的最大允许连续输出转矩与电源频率的 关系。输出转矩表示为电机标称转矩的百分比。

6.7.3 ACS550/580 系列与其他电压源变频器的电机负载能力

图 9 和图 10 所示的负载率曲线（或负载能力曲线）给出了电机的最大允许连续输出转矩与电源频率的关系。输出转矩表示为电机标称转矩的百分比。

注意！
图 9 和图 10 中的负载率曲线基于 3 kHz 开关频率。

对于恒定转矩应用，允许的最低连续工作频率为 15 Hz。

对于平方转矩应用，允许的最低连续工作频率为 5 Hz。

ACS 500 系列之外的其他电压源变频器的组合必须通过测试或连接温度传感器来控制表面温度。

6.7.4 短时过载

ABB 隔爆型电机通常允许短时过载。欲知确切的值，请参见电机铭牌或联系 ABB。

过载能力由三个因素来规定：

I_{OL} 最大短时电流
T_{OL} 允许的过载时长
T_{COOL} 每次过载后需要的冷却时间。冷却期间，电机电流和转矩必须低于允许的连续负载限值。

6.8 铭牌

针对变速运行必须提供 VSD 铭牌，其中应包含定义变速运行允许的工作范围所需的数据。设计用于在爆炸环境进行变速工作的电机铭牌上至少应显示下列参数：

– 工作类型
– 负载类型（恒转矩或平方转矩）
– 变频器类型和最小开关频率
– 功率或转矩限制
– 转速或频率限制

6.8.1 标准 VSD 铭牌的内容

标准 VSD 铭牌包含以下信息：

- 驱动器的电源电压或电压范围 (VALID FOR) 及电源频率 (FWP)
- 电机类型
- PWM 变频器的最小开关频率 (MIN.SWITCHING FREQ.FOR PWM CONV.)
- 短时过载限值 (I OL, T OL, T COOL)，参见第 6.7.4 节
- DTC 控制 ACS800/880 变频器的允许负载转矩 (DTC-CONTROL)。负载转矩表示为电机标称转矩的百分比。
- PWM控制ACS550/580变频器的允许负载转矩 (PWM-CONTROL)。负载转矩表示为电机标称转矩的百分比。另请参见第 6.7.3 节。

标准 VSD 铭牌需要用户将一般数据转换为特定电机的数据。为将频率限制转换为速度限制，以及将转矩限制转换为电流限制，需要参照危险区域用电机产品目录。如需定制铭牌，可向 ABB 申请。

6.8.2 客户定制 VSD 铭牌的内容

客户定制 VSD 铭牌包含针对变速操 作的特定应用和电机数据，如下所示：

- 电机类型
- 电机序列号
- 变频器类型 (FC Type)
- 开关频率 (Switc. freq.)
- 电机的弱磁点或额定点 (F.W.P.)
- 特定工作点列表
- 负载类型（CONSTANT TORQUE、QUADRATIC TORQUE 等）
- 转速范围
- 如果电机配有适合直接进行温度控制的热传感器，则会显示“PTC xxx C DIN44081/-82”字样。其中 "xxx" 标注了传感器的触发温度。

在客户定制 VSD 铭牌上技术数据针对特定电机与应用。 大多数情况下，工作点值可用于变频器保护功能的编程。

6.9 变速应用调试

变速应用调试必须根据本手册和相应变频器手册提供的说明以及当地法律法规进行。同时必须考虑应用的要求和限制。

设置变频器最常用的参数有：

– 电机标称
  - 电压
  - 电流
  - 频率
  - 速度
  - 功率

这些参数应当从固定于电机上的标准铭牌的同一行获取。

> **注意！**
> 当信息缺失或不准确时，必须确保设置正确，方能运行电机！

建议利用变频器的所有合适防护功能来提高应用的安全性。变频器通常提供这些功能：

– 最小转换
– 最大转换
– 失速保护
– 加速和减速时间
– 最大电流
– 最大功率
– 最大转矩
– 用户负载曲线

> **警告**
> 这些只是附加功能，并不能取代当地安全法规或标准要求的安全功能。

6.9.1 根据 VSD 铭牌设置参数

检查 VSD 铭牌是否适合目标应用，即供电网络是否与 "FWP" 数据一致以及是否达到为变频器设置的要求（变频器的类型与控制类型以及开关频率）

检查负载是否符合所用变频器允许的负载。

输入基本启动数据。变频器的基本启动数据应从铭牌（示例见图 I3）获取。详细说明参见相应变频器的手册。

对于 ABB 提供的变频器，例如 ACS800、ACS880、ACS550 等，所有的参数设置都可以从相应手册中找到。在所有的变频器中，至少下列参数设置会影响电机温度；最小开关频率，必须检查，防止在弱磁点及以上过度调制。

7. 维护

警告
停机时，接线盒内可能接有用于加热元件或直接绕组加热的电压。

警告
必须考虑与爆炸环境用电气设备的修理和维护相关的标准 IEC/EN 60079-17 和 -19。只有熟悉这些标准的合格人员才能处理此类设备。

根据工作的性质，在电机或从动设备上工作之前，应断开电源并上锁。工作进行中，确保不存在爆燃性气体或粉尘。

IEC/EN 60079-17 不适用于 M3JM 和 M3KM 电机。

7.1 常规检查

1. 标准 IEC/EN 60079-17（尤其是表 1-4）应当用作检查和维护的指南。
2. 定期检查电机。检查的频率取决于环境空气湿度和当地气候条件等因素。刚开始时可通过实验确定检查频率，之后必须严格遵守。
3. 保持电机清洁，并确保空气自由流通。如果在灰尘过多的环境中使用电机，必须定期检查和清洁通风系统。
4. 检查轴密封件（例如 V 形环或径向密封件）的情况，必要时更换密封件。
5. 对于 Ex t 电机，应根据 IEC/EN 60079-17 表 4 执行详细检查，推荐检查间隔为 2 年或 8000 小时。
6. 检查连接件、安装和组装螺栓的情况。
7. 通过监听是否存在不正常的噪音、振动测量、轴承温度测量，检查用过的润滑油或监视 SPM 轴承来检查轴承情况。对于即将达到计算的额定寿命的轴承，应尤其注意。

当出现磨损迹象时，应拆卸电机，检查零部件，必要时予以更换。更换轴承时，替代轴承的型号必须与原安装的轴承型号完全相同，轴密封件必须用质量和特性均与原密封件相同的密封件更换。

对于隔爆型电机，应定期打开排水塞（如有）。逆时针转动即可打开排水塞，轻轻敲击，检查能否正常工作；按住并顺时针转动可关闭排水塞。此操作必须在电机处于静止状态时执行。检查的频率取决于环境空气湿度和当地气候条件。刚开始时可通过实验确定检查频率，之后必须严格遵守。

对于防护等级为 IP 55 的电机，如果电机在交付时已塞上排水塞，建议定期打开排水塞，以确保冷凝水通路不被堵塞，可以从电机中流出。此操作必须在电机处于静止状态且可以在其上安全工作时执行。

7.1.1 备用电机

如果电机在船上或其他振动环境下较长时间处于待命状态，必须采取如下措施：

1. 每两周通过启动系统来旋转电机轴（需予以上报）。如果因故不能启动，必须用手转动电机轴，使其处于不同的位置，至少每周一次。船上其他设备造成的振动会引起轴承点蚀，应通过定期操作/手动运转使点蚀最小。
2. 每年必须润滑轴承，同时旋转电机轴（需予以上报）。如果电机的从动端配有滚柱轴承，则旋转轴之前，必须拆除运输锁。运输时，必须重新装上运输锁。
3. 必须消除一切振动，以免轴承出现故障。此外，必须遵守电机手册中关于调试和维护的所有说明。否则，绕组和轴承损坏将得不到质保。

7.2 润滑

警告
请留意所有转动部件。

警告
润滑油可能会引发皮炎和眼炎。请遵守润滑油制造商规定的所有安全防范措施。

轴承类型在相关的产品目录以及所有电机（除较小机座规格的电机外）的铭牌上指明。

可靠性是轴承润滑间隔时间的关键考虑因素。ABB 对润滑采用 L1 原则（即 99% 的电机必须达到工作寿命）。

7.2.1 装有永久润滑轴承的电机

轴承通常采用 1Z、2Z、2RS 或同类永久润滑轴承。

一般来说，按照 L_1 对机座规格为 250 及以下的电机进行足够润滑，可以达到如下工作时间。若要在较高环境温度下工作，请联系 ABB。可以用下式将 L_1 值粗略地换算为 L_{10} 值：$L_{10} = 2.7 \times L_1$.

环境温度为 25°C 和 40°C 时，永久润滑轴承的工作小时数为：

机座规格	极数	25°C 时的工作小时数	40°C 时的工作小时数
71	2	67 000	42 000
71	4 – 8	100 000	56 000
80 – 90	2	100 000	65 000
80 – 90	4 – 8	100 000	96 000
100 – 112	2	89 000	56 000
100 – 112	4 – 8	100 000	89 000
132	2	67 000	42 000
132	4 – 8	100 000	77 000
160	2	60 000	38 000
160	4 – 8	100 000	74 000
180	2	55 000	34 000
180	4 – 8	100 000	70 000
200	2	41 000	25 000
200	4 – 8	95 000	60 000
225	2	36 000	23 000
225	4 – 8	88 000	56 000
250	2	31 000	20 000
250	4 – 8	80 000	50 000

数据在最高 60 Hz 频率下有效。

7.2.2 装有可补充润滑油轴承的电机

润滑信息铭牌和一般润滑建议
如果电机配有润滑信息铭牌，请遵守其给出的数值。

在润滑信息牌上定义了与安装、环境温度和转速相关的润滑间隔。

第一次启动期间或轴承润滑后，可能会出现暂时的温度升高，持续 10 到 20 小时左右。

一些电机可能配有陈油收集器。请遵守针对该设备的特别说明。

对 Ex t 电机添加润滑油后，应清洁电机端盖，使其无灰尘。

A. 手动润滑

在电机运转时添加润滑油
- 取下放油口塞或打开隔断阀（若有）。
- 确保润滑通道已打开。
- 将指定量的润滑油注入轴承。
- 让电机运行 1-2 小时，确保所有多余的润滑油都被甩出轴承。– 关闭放油口塞或隔断阀（若有）。

在电机停机时添加润滑油
如果不能在电机运转时为轴承添加润滑油，可以在机器停机时进行润滑。
- 这种情况下，请使用一半的润滑油量，然后让电机全速运转几分钟。
- 电机停止后，补足注入轴承的润滑油量。
- 运转 1-2 小时后，关闭放油口塞或隔断阀（若有）。

B. 自动润滑
如采用自动润滑，必须永久性地卸下放油口塞或打开隔断阀（若有）。

ABB 建议仅使用机电系统。

如果使用中央润滑系统，每一润滑间隔时间的润滑油量应为表 中数值的三倍。如果自动补充润滑油单元较小（每台电机一到两个油盒），也可以使用正常的润滑油量。

如果对 2 极电机进行自动润滑，应遵守“润滑剂”一章中关于 2 极电机润滑建议的注意事项。

所用的润滑油应适合自动润滑。应注意自动润滑系统供应商和润滑油制造商的建议。

自动润滑系统润滑油量计算示例
中央润滑系统：电机 IEC M3_P 315_ 4-极，50 Hz 网络，从下表中查得润滑价格时间为 7600 h/55 g (DE) 和 7600 h/40 g (NDE)：

(DE) RLI = 55 g/7600 h*3*24 = 0.52 g/日
(NDE) RLI = 40 g/7600h*3*24 = 0.38 g/日

单一自动润滑单元（油盒）润滑油量计算示例
(DE) RLI = 55 g/7600 h*24 = 0,17 g/日
(NDE) RLI = 40 g/7600 h*24 = 0,13 g/日

RLI = 润滑间隔时间，DE = 驱动端，NDE = 非驱动端

7.2.3 润滑间隔时间和润滑油量

立式机器的润滑间隔时间为下表所示数值的一半。

一般来说，根据 L1 按以下间隔可以实现充分润滑。若要在较高环境温度下工作，请联系 ABB。可以用下式将 L1 值粗略地换算为 L10 值：L10 = 2.0 x L1
手动润滑

润滑间隔时间基于轴承工作温度 80°C（环境温度 +25°C）。

> **注意！**
> 环境温度升高会相应提高轴承温度。轴承温度升高 15°C 时，间隔时间应减半；轴承温度下降 15°C 时，间隔时间可加倍。

高速运转（如变频器应用）或低转速重负荷运转要求较短的润滑间隔时间。

> **警告**
> 不得超出润滑油和轴承的最高工作温度 +110°C。
>
> 不得超出电机的设计最高转速。

球轴承

机座规格	润滑脂量 DE 轴承 [g]	润滑脂量 NDE 轴承 [g]	3600 转/分	3000 转/分	1800 转/分	1500 转/分	1000 转/分	500-900 转/分
			工作期间的润滑间隔时间					
160	13	13	7 100	8 900	14 300	16 300	20 500	21 600
180	15	15	6 100	7 800	13 100	15 100	19 400	20 500
200	20	15	4 300	5 900	11 000	13 000	17 300	18 400
225	23	20	3 600	5 100	10 100	12 000	16 400	17 500
250	30	23	2 400	3 700	8 500	10 400	14 700	15 800
280	35	35	1 900	3 200	–	–	–	–
280	40	40	–	–	7 800	9 600	13 900	15 000
315	35	35	1 900	3 200	–	–	–	–
315	55	40	–	–	5 900	7 600	11 800	12 900
355	35	35	1 900	3 200	–	–	–	–
355	70	40	–	–	4 000	5 600	9 600	10 700
400	40	40	1 500	2 700	–	–	–	–
400	85	55	–	–	3 200	4 700	8 600	9 700
450	40	40	1 500	2 700	–	–	–	–
450	95	70	–	–	2 500	3 900	7 700	8 700

滚柱轴承

机座规格	润滑脂量 DE 轴承 [g]	润滑脂量 NDE 轴承 [g]	3600 转/分	3000 转/分	1800 转/分	1500 转/分	1000 转/分	500-900 转/分
			工作期间的润滑间隔时间					
160	13	13	3 600	4 500	7 200	8 100	10 300	10 800
180	15	15	3 000	3 900	6 600	7 500	9 700	10 200
200	20	15	2 100	3 000	5 500	6 500	8 600	9 200
225	23	20	1 800	1 600	5 100	6 000	8 200	8 700
250	30	23	1 200	1 900	4 200	5 200	7 300	7 900
280	35	35	900	1 600	–	–	–	–
280	40	40	–	–	4 000	5 300	7 000	8 500
315	35	35	900	1 600	–	–	–	–
315	55	40	–	–	2 900	3 800	5 900	6 500
355	35	35	900	1 600	–	–	–	–
355	70	40	–	–	2 000	2 800	4 800	5 400
400	40	40	–	1300	–	–	–	–
400	85	55	–	–	1 600	2 400	4 300	4 800
450	40	40	–	1 300	–	–	–	–
450	95	70	–	–	1 300	2 000	3 800	4 400

7.2.4 润滑油

警告
不得混用不同型号的润滑油。
性质不相容的润滑油可能会导致轴承损坏。

添加润滑油时，只能使用具有以下特性的球轴承润滑油：

– 含有锂复合基以及矿物油或 PAO 油的优质润滑油
– 40°C时基油粘度为 100-160 cST
– 稠度为 NLGI 级 1.5 - 3 *)
– 温度范围为 -30°C - +140°C（连续）。

*) 对于垂直安装的电机或处于高温环境条件下，建议以较高值为准。

上述润滑油规格的有效条件是环境温度高于 -30°C 或低于 +55°C，且轴承温度低于 110°C。其他情况下，请咨询 ABB 应采用何种润滑油。

所有主要润滑剂制造商都提供特性正确的润滑脂。

建议使用外加剂，但必须向润滑剂制造商索取书面保证，即在工作温度范围内，外加剂不会损坏轴承或降低润滑剂的性能，这一点对 EP 外加剂尤其重要。

警告
对于 280 到 450 的机座规格，如果轴承温度很高，建议不要使用含有 EP 外加剂的润滑油。

可以使用下列高性能润滑油：

– Mobil Unirex N2 或 N3（复合锂基）
– Mobil Mobilith SHC 100（复合锂基）
– Shell Gadus S5 V 100 2（锂复合基）
– Klüber Klüberplex BEM 41-132（专用锂基）
– FAG Arcanol TEMP110（锂复合基）
– Lubcon Turmogrease L 802 EP PLUS（专用锂基）
– Total Multiplex S2 A（锂复合基）
– Rhenus Rhenus LKZ 2（锂复合基）

注意！
对于速度系数高于 480,000（用 Dm x n 计算，其中 Dm = 轴承平均直径，单位为 mm；n = 转速，单位为 r/min）的高速 2 极电机，务必使用高速润滑油。

下列润滑油可用于高速铸铁电机，但不能与锂复合润滑油混合使用：

– Klüber Klüber Quiet BQH 72-102（聚脲基）
– Lubcon Turmogrease PU703（聚脲基）

如果使用其他润滑剂，请咨询制造商，了解其质量是否达到上述润滑剂的水平。润滑间隔时间基于上面所列高性能润滑油。使用其他润滑油可能要缩短间隔时间。

8.售后支持

8.1 备件

除非另有说明，必须使用原厂零部件或 ABB 核准的备件。

必须遵守标准 IEC/EN 60079-19 中的要求。

订购备件时，必须指明铭牌所示的电机序列号、完整的型号名称和产品代码。

8.2 拆卸、重新组装和绕组重绕

遵从标准 IEC/EN 60079-19 中关于拆卸、重新组装和绕组重绕的说明。**任何操作都必须由制造商，即 ABB 或 ABB 授权维修合作伙伴执行。**

对于构成防爆外壳的部件和确保防尘的部件，不得进行任何制造变更。另外，必须确保通风畅通无阻。

绕组重绕必须由 ABB 授权的维修合作伙伴执行。

8.3 轴承

拆装轴承时必须特别小心。

轴承必须用拉出器拆卸，安装时必须预热或使用专用工具。

轴承的更换方法在单独的说明书中有详细说明，该说明书可向 ABB 销售办事处索取。更换 Ex t 电机的轴承时，需要遵从一些特别建议（因为同时应更换密封件）。

必须注意贴在电机上的任何指示，如标签等。轴承型号必须与铭牌上给出的型号一致。

注意！
除非制造商明确批准，否则最终用户执行的任何维修都会免除制造商的合规性责任。

8.4 垫圈和密封件

非 Ex d 接线盒都配有经过测试和认可的密封件。需要更换垫圈和/或密封件时，必须使用原装备件更换。

8.5 隔爆接合面的维护

当隔爆接合面需要维修时，必须联系制造商并按其规定的隔爆接合面尺寸进行维修。

9. 环境要求

50 Hz 时，ABB 大多数电机的声压级均不超过 82 dB(A) (± 3 dB)。

特定电机的数据可在相关产品目录中找到。在 60 Hz 正弦电源下，其数值比产品目录中 50 Hz 时的数值高出大约 4 dB(A)。

有关变频器电源的声压级，请联系 ABB。

当电机需要报废或回收时，必须遵循当地法规。

10. 故障排除

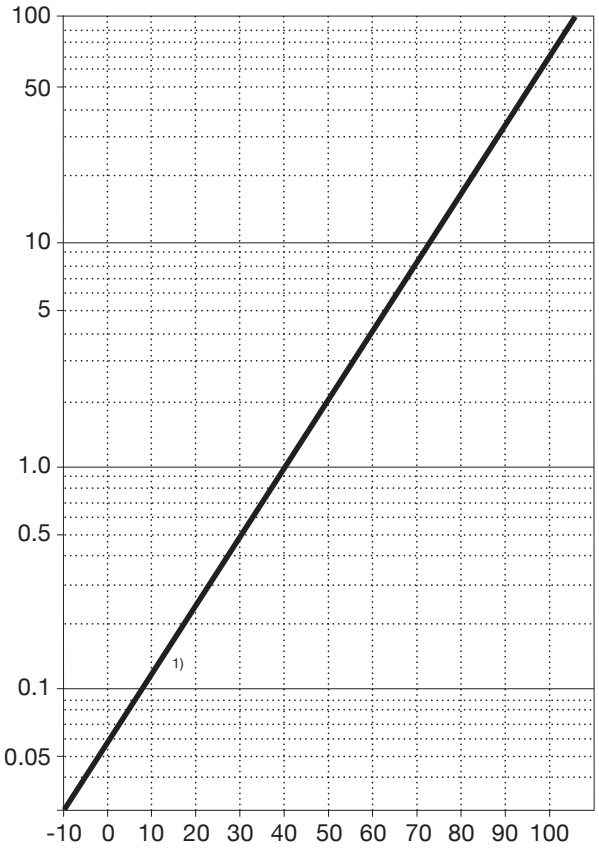
这些说明并未包含设备的所有细节或变动，也未提供有关安装、操作或维护时应当满足的所有可能条件的相关信息。如需了解其他信息，请联系附近的 ABB 销售办事处。

电机故障排除图表
电机维修和故障排除必须由具备适当工具和设备的合格人员执行。

故障	原因	纠正措施
电机不能启动	保险丝熔断	换上正确型号和额定值的保险丝。
	过载跳闸	检查启动器中的过载并复位。
	电源不正确	查看电源是否符合电机铭牌上的说明和负载系数。
	线路连接不正确	对照随电机提供的接线图检查连接。
	绕组或控制开关开路	开关闭合时有嗡嗡声检查是否有线路松动并确保所有控制接触器都闭合。
	机械故障	检查电机和传动装置是否能自由转动。检查轴承和润滑。
	定子短路 定子线圈连接不良	保险丝熔断。电机绕组必须重绕。拆除端罩，定位故障。
	转子有缺陷	查找断条或端环。
	电机可能过载	降低负载。
电机失速	可能发生断相	检查线路有无断相。
	应用错误	更改型号或规格。咨询设备供应商。
	过载	降低负载。
	电压过低	确保维持铭牌所示电压。检查连接情况。
	开路	保险丝熔断。检查过载继电器、定子和按钮。
电机运转，然后逐渐停下	电源故障	检查线路、保险丝或控制器的接线有无松动。
电机不能达到标称转速	未恰当应用	咨询设备供应商型号是否正确。
	线路压降导致电机端子电压过低	使用更高电压或变压器端子，或者降低负载。检查连接情况。检查导线规格是否正确。
	启动负载过高	检查电机在“空载”下的启动情况。
	转子断条或松动	检查端环附近有无裂纹。可能需要更换转子，因为维修通常只能暂时解决问题。
	主电路开路	用测试装置定位故障并修理。
电机加速时间太长和/或消耗电流过高	负载过大	降低负载。
	启动期间电压过低	检查电阻是否过高。确保所用的电缆规格正确。
	鼠笼式转子有缺陷	更换新转子。
	施加的电压过低	校正电源。

故障	原因	纠正措施
旋转方向错误	相序错误	对调电机或配电盘上的接线。
电机运转期间过热	过载	降低负载。
	机座或通风口被污垢堵塞，妨碍电机通风	琉通通风孔并检查是否有气流从电机持续送出。
	电机可能发生断相	检查确认所有线路连接良好。
	线圈接地	电机绕组必须重绕。
	端子电压不平衡	检查导线、接头和变压器有无故障。
电机振动	电机未对准	重新对准。
	支撑不稳	加固底座。
	联轴器不平衡	平衡联轴器。
	从动设备不平衡	重新平衡从动设备。
	轴承有缺陷	更换轴承。
	轴承未对中	修理电机。
	平衡块移动	重新平衡转子。
	电机与联轴器的平衡矛盾 (半键 - 全键)	重新平衡联轴器或转子。
	多相电机以单相运行	检查有无开路。
	轴端余隙过大	调整轴承或增加薄垫片。
刮擦噪音	风扇摩擦端罩或风扇盖	校正风扇安装。
	电机在台板上松动	拧紧紧固螺栓。
运行嘈杂	气隙不均匀	检查并校正端罩配合或轴承配合。
	转子不平衡	重新平衡转子。
轴承过热	轴弯曲或扭曲	矫正或更换轴。
	皮带拉力过大	减小皮带张紧度。
	皮带轮离开轴肩太远	移动皮带轮，使其更靠近电机轴承。
	皮带轮直径过小	使用更大的皮带轮。
	未对准	通过重新对准传动装置来纠正。
	润滑不足	使轴承保有适当质量和数量的润滑油。
	润滑油变质或手动污染	去除旧润滑油，用煤油彻底清洗轴承并换上新润滑油。
	润滑油过多	减少润滑油量：轴承内油量不应超过 1/2。
	轴承过载	检查对准情况、侧推力和端面推力。
	滚珠损坏或底圈凹凸不平	彻底清洁轴承座，然后更换轴承。

11. 图



键

X 轴：绕组温度，摄氏度

Y 轴：绝缘电阻温度系数，ktc

1) 要按 40°C 纠正测得的绝缘电阻 R_i, 将其与温度系数 k_{tc} 相乘。$R_{i\ 40°C} = R_i$ x

图 1. 图中所示为绝缘电阻与温度的关系以及如何将测得的绝缘电阻按 40°C 纠正。

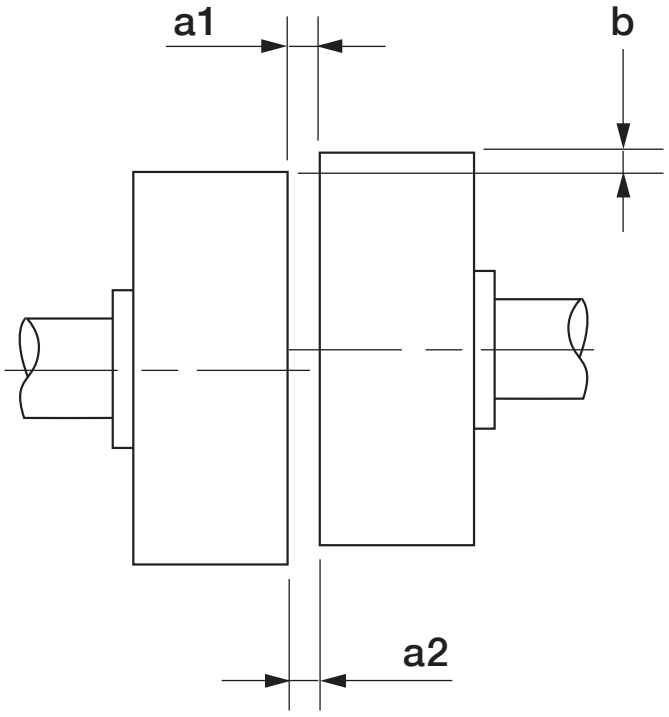


图 2. 半联轴器或皮带轮的安装

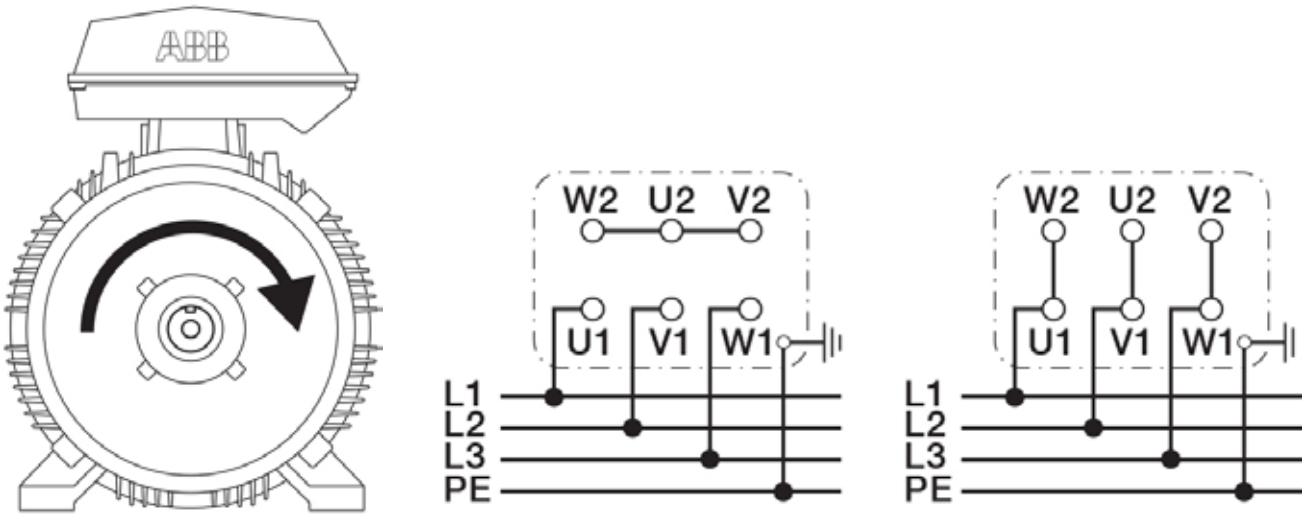
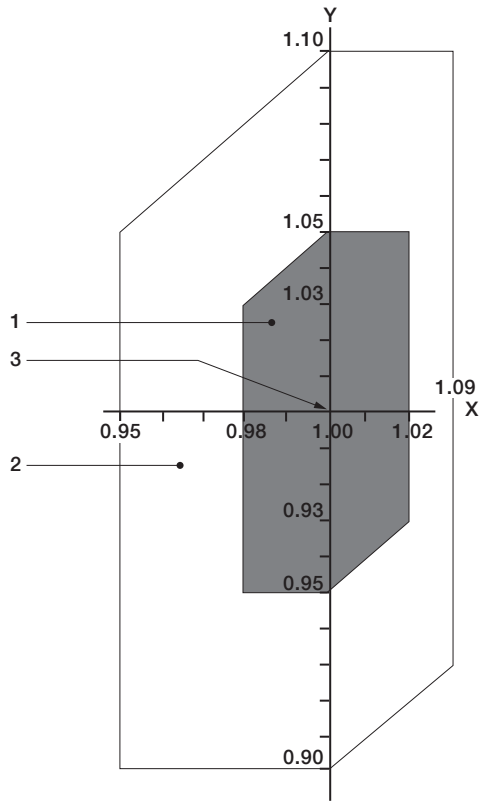


图 3.　　主电源的连接端子



键	
X 轴	频率 p.u.
Y 轴	电压 p.u.
1	A 区
2	B 区（A 区以外）
3	额定点

图 4.　　A 区和 B 区的电压和频率偏差

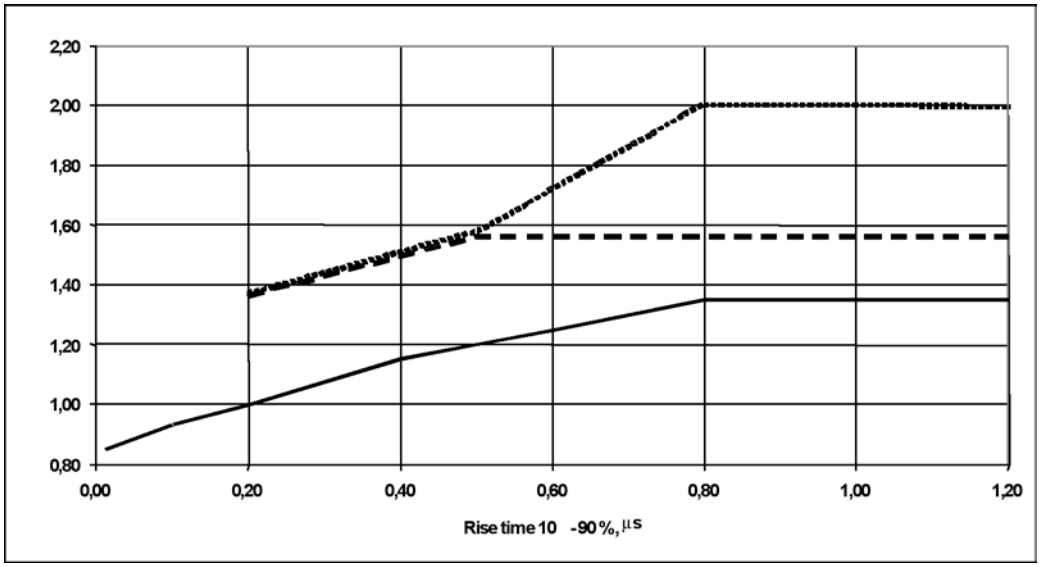
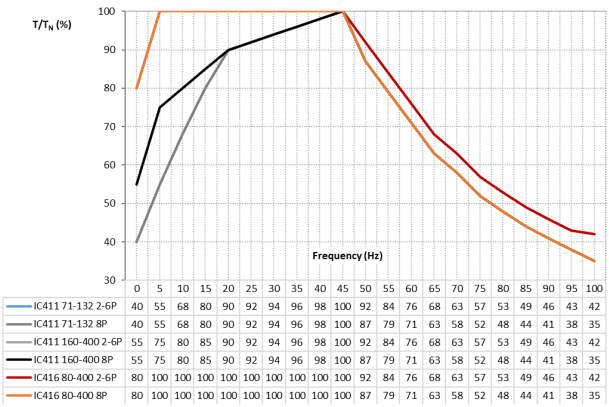


图 5. 电机端子允许的相间电压峰值与上升时间的关系。

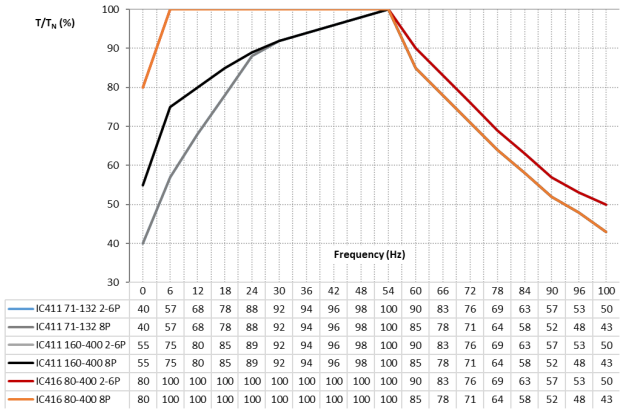
使用 ACS800/880 变频器时的负载能力曲线

使用 ABB ACS 800/880 变频器时的负载能力，DTC 控制隔爆型电机 Ex d/Ex db / Ex de/Ex db eb T4， 机座规格 80 - 400 以及粉尘防 爆型电机 Ex t ，机座规格 71 - 400 / 50Hz



	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
IC411 71-132 2-6P	40	55	68	80	90	92	94	96	98	100	92	84	76	68	63	57	53	49	46	43	42
IC411 71-132 8P	40	55	68	80	90	92	94	96	98	100	87	79	71	63	58	52	48	44	41	38	35
IC411 160-400 2-6P	55	75	80	85	90	92	94	96	98	100	92	84	76	68	63	57	53	49	46	43	42
IC411 160-400 8P	55	75	80	85	90	92	94	96	98	100	87	79	71	63	58	52	48	44	41	38	35
IC416 80-400 2-6P	80	100	100	100	100	100	100	100	100	100	92	84	76	68	63	57	53	49	46	43	42
IC416 80-400 8P	80	100	100	100	100	100	100	100	100	100	87	79	71	63	58	52	48	44	41	38	35

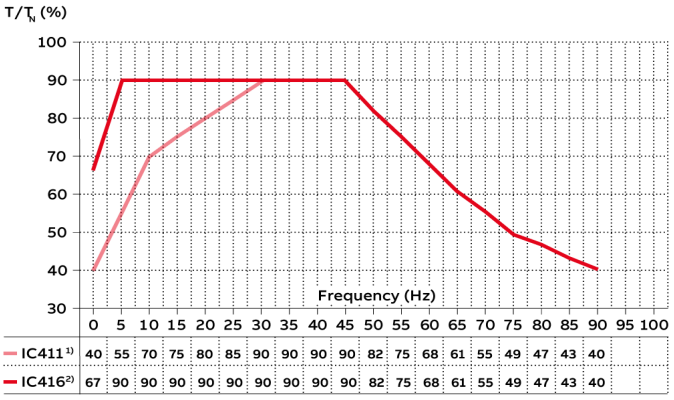
使用 ABB ACS 800/880 变频器时的负载能力，DTC 控制隔爆型电机 Ex d/Ex db / Ex de/Ex db eb T4，机座规格 80 - 400 以及粉尘防爆型电机 Ex t ,机座规格 71 - 400 / 60Hz



	0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	100
IC411 71-132 2-6P	40	57	68	78	88	92	94	96	98	100	90	83	76	69	63	57	53	50
IC411 71-132 8P	40	57	68	78	88	92	94	96	98	100	85	78	71	64	58	52	48	43
IC411 160-400 2-6P	55	75	80	85	89	92	94	96	98	100	90	83	76	69	63	57	53	50
IC411 160-400 8P	55	75	80	85	89	92	94	96	98	100	85	78	71	64	58	52	48	43
IC416 80-400 2-6P	80	100	100	100	100	100	100	100	100	100	90	83	76	69	63	57	53	50
IC416 80-400 8P	80	100	100	100	100	100	100	100	100	100	85	78	71	64	58	52	48	43

图 6. 隔爆型电机 Ex d/Ex db / Ex de/Ex db eb T4，铸铁粉尘防爆型电机 Ex t ； 电机标称频率为 50/ 60 Hz

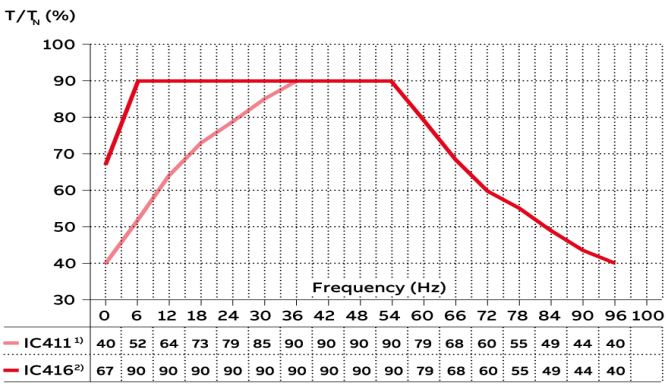
使用 ABB ACS 800/880 变频器时的负载能力，DTC 控制增安型电机 Ex ec/Ex nA T3， 机座规格 71 - 450 以及粉尘防爆型电 机 Ex t/Ex tD，机座规格 71 - 450 / 50Hz



	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
IC411 [1]	40	55	70	75	80	85	90	90	90	90	82	75	68	61	55	49	47	43	40		
IC416 [2]	67	90	90	90	90	90	90	90	90	90	82	75	68	61	55	49	47	43	40		

[1] 自通风，IEC 机座规格 71 - 450
[2] 独立电机冷却（强制通风）

使用 ABB ACS 800/880 变频器时的负载能力，DTC 控制增安型电机 Ex ec/Ex nA T3， 机座规格 71 - 450 以及粉尘防爆型电 机 Ex t/Ex tD，机座规格 71 - 450 / 60Hz

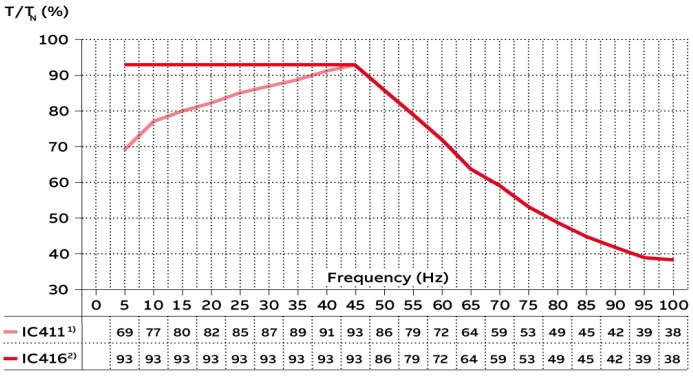


	0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	100
IC411 [1]	40	52	64	73	79	85	90	90	90	90	79	68	60	55	49	44	40	
IC416 [2]	67	90	90	90	90	90	90	90	90	90	79	68	60	55	49	44	40	

[1] 自通风，IEC 机座规格 71 - 450
[2] 独立电机冷却（强制通风）

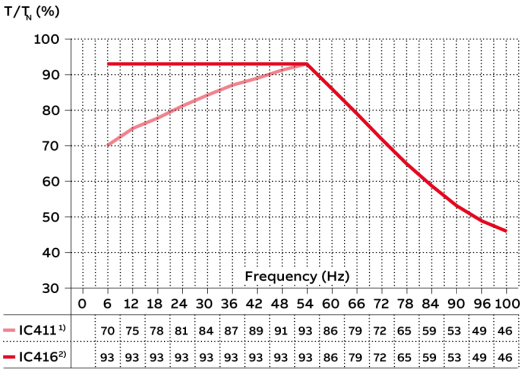
图 7. 增安型电机Ex ec/ Ex nA，铸铁和铝质粉尘防爆型电机 Ex t/Ex tD ；电机标称频率为 50/60 Hz

使用 ABB ACS 800/880 变频器时的负载能力，DTC 控制隔爆型电机 Ex d/Ex db/ Ex de/Ex db eb T4， 机座规格 450 以及粉尘防爆型 电机 Ex t，机座规格 450 / 50Hz



1) 自通风，IEC 机座规格 450
2) 独立电机冷却（强制通风）

使用 ABB ACS 800/880 变频器时的负载能力，DTC 控制隔爆型电机 Ex d/Ex db/ Ex de/Ex db eb T4， 机座规格 450 以及粉尘防爆型 电机 Ex t，机座规格 450 / 60Hz

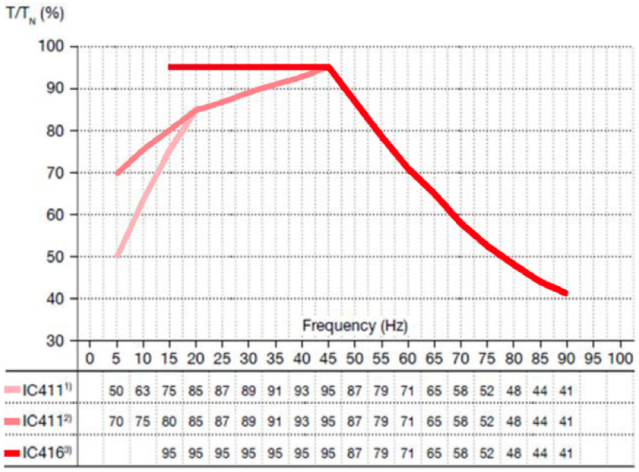


1) 自通风，IEC 机座规格 450
2) 独立电机冷却（强制通风）

图8. 隔爆型电机 Ex d/Ex db / Ex de/Ex db eb T4，铸铁粉尘防爆型电机 Ex tD； 电机标称频率为 50/60 Hz

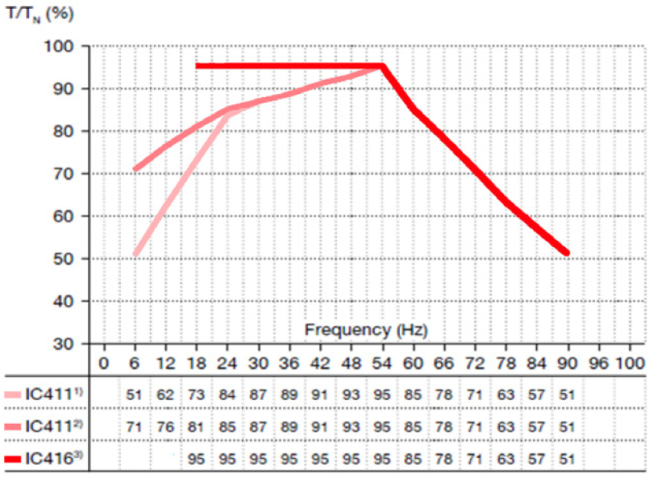
使用 ACS550/580变频器和其他电压源变频器时的负载率曲线

使用 ABB ACS 550/580变频器的负载能力， 隔爆型电机 Ex d/Ex db / Ex de /Ex db eb T4，机座规格 80 - 400 和粉尘防爆 型电机 Ex t ，机座规格 71 - 400 / 50Hz



[1] 自通风，IEC 机座规格 71 - 132
[2] 自通风，IEC 机座规格 160 - 400
[3] 独立电机冷却（强制通风）

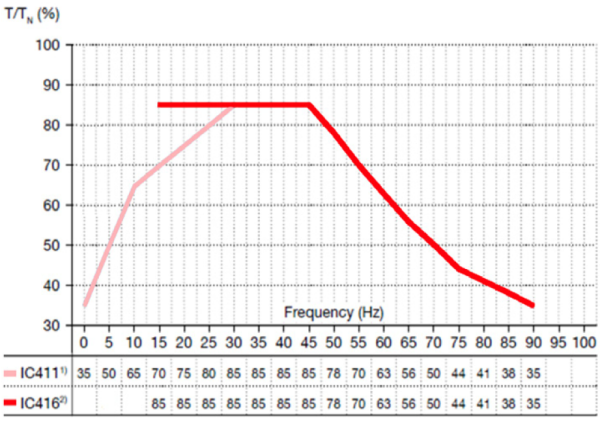
使用 ABB ACS 550/580变频器的负载能力， 隔爆型电机 Ex d/Ex db / Ex de /Ex db eb T4，机座规格 80 - 400 和粉尘防爆 型电机 Ex t ，机座规格 71 - 400 / 60Hz



[1] 自通风，IEC 机座规格 71 - 132
[2] 自通风，IEC 机座规格 160 - 400
[3] 独立电机冷却（强制通风）

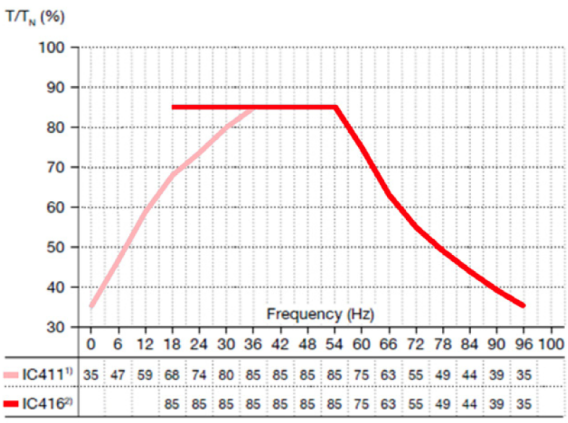
图 9. 隔爆型电机 Ex d/Ex db/Ex de/Ex db eb T4，铸铁粉尘防爆型电机 Ex t ；电机标称频率为 50/ 60 Hz

使用 ABB ACS 550/580变频器的负载能力， 增安型电机 Ex ec/Ex nA T3，机座规格 71 - 450 和粉尘防爆型电机 Ex t/ Ex tD ，机座规格 71 - 450 / 50Hz



[1] 自通风，IEC 机座规格 71 - 450
[2] 独立电机冷却（强制通风）

使用 ABB ACS 550/580变频器的负载能力， 增安型电机 Ex ec/Ex nA T3，机座规格 71 - 450 和粉尘防爆型电 机 Ex t/ Ex tD ，机座规格 71 - 450 / 60Hz



[1] 自通风，IEC 机座规格 71 - 450
[2] 独立电机冷却（强制通风）

图 10. 增安型电机 Ex ec/Ex nA，铸铁粉尘防爆型电机 Ex t/Ex tD ；电机标称频率为 50/60 Hz

Low voltage Motors for explosive atmospheres

Safety Manual

Table of Contents

1. Introduction

NOTE!

These instructions must be followed to ensure safe and proper installation, operation and maintenance of the motor. They should be brought to the attention of anyone who installs, operates or maintains the motor or associated equipment. Ignoring these instructions may invalidate all applicable warranties.

WARNING

Motors for explosive atmospheres are specially designed to comply with official regulations concerning the risk of explosion. The reliability of these motors may be impaired if they are used improperly, badly connected, or altered in any way no matter how minor.

Standards relating to the connection and use of electrical apparatus in hazardous areas must be taken into consideration, especially the national standards for installation in the country where the motors are being used. Only trained personnel familiar with these standards should handle this type of apparatus.

1.1 EU Declaration of Conformity

Declaration of Conformity with respect to the Directive 2014/34/EU (ATEX) see appendix.

The conformity of the end product according to theDirective 2006/42/EC (Machinery) has to beestablished by the commissioning party when the motor is fitted to the machinery.

Products in consistence with the regulation of Three-Phase Asynchronous Motor Energy Efficiency Label have been registered in the official website of ChinaEnergy Label, and CEL (China Energy Label) is stuck onthe motor body per the regulation. Energy efficiency label pattern comply with the requirements of the regulation, Energy efficiency grade and energy efficiency testing mothed conform to the requirements of GB18613. For detail registration information, please visit the official website www.energylabel.com.cn.

1.2 Validity

These instructions are valid for the following ABB electrical motor types, when used in explosive atmospheres.

Increased safety Ex ec/Ex nA
series M2A*/M3A*/ M3B*/M3G*

Increased safety Ex e,Ex eb
series M3H*

Flameproof enclosure Ex d, Ex de, Ex db, Ex db eb
series M3KP/M3JP/IE4 M3JP

Dust ignition protection (Ex t)
series M2A*/M3A*/M3JP/IE4 M3JP/M3B*/M3D*/M3G*

(Additional information may be required by ABB when deciding on the suitability of certain motor types used inspecial applications or with special design modifications.)

These instructions are valid for motors installed and stored in ambient temperatures above –20 °C and below +50 °C. Note that the motor range in question is suitable for this whole range. In ambient temperatures exceeding these limits, please contact ABB.

1.3 Conformity

As well as conforming to the standards relating to mechanical and electrical characteristics, motors designed for explosive atmospheres must also conform to one or more of the following European or IEC-standards for the protection type in question:

Product standards

IEC/EN 60079-0, GB/T3836.1	Equipment - General requirements
IEC/EN 60079-1, GB/T3836.2	Equipment protection by flameproof enclosures ”d”
IEC/EN 60079-7, GB/T3836.3	Equipment protection by increased safety ”e”
IEC/EN 60079-15, GB/T3836.8	Equipment protection by type of protection ”n”
IEC/EN 60079-31, GB/T3836.31	Equipment dust ignition protection by enclosure ”t”
IEC 60050-426, GB/T2900.35	Equipment for explosive atmospheres

Installation standards

IEC/EN 60079-14, GB/T3836.15	Electrical installations design, selection and erection
IEC/EN 60079-17, GB/T3836.16	Electrical installations inspections and maintenance
IEC/EN 60079-19, GB/T3836.13	Equipment repair, overhaul and reclamation
IEC 60050-426, GB/T2900.35	Equipment for explosive atmospheres
IEC/EN 60079-10, GB/T3836.14	Classification of hazardous area (gas areas)
IEC 60079-10-1, GB/T3836.14	Classification of areas – Explosive gas atmospheres
IEC 60079-10-2, GB/T3836.14	Classification of areas – Combustible dust atmospheres
EN 1127-1, -2	Explosive prevention and protection

ABB IEC LV motors (valid for Group I, II and III of the Directive 94/9/EC or 2014/34/EU) can be installed in areas corresponding to the following markings:

Zone	Equipment protection levels (EPLs)	Category	Protection type
1	'Gb'	2G	Ex db/Ex db eb
2	'Gb' or 'Gc'	2G or 3G	Ex db/Ex db eb
21	'Db'	2D	Ex t
22	'Db' or 'Dc'	2D or 3D	Ex t
–	'Mb'	M2	Ex db/Ex db eb

Atmosphere:
G – explosive atmosphere caused by gases
D – explosive atmosphere caused by combustible dust
M – mines susceptible to firedamp

1.4 Product Type

Example:

IE4 M3JP 200 ML A 2

- 2 — Pole
- A — Iron core code (A,B,C,D)
- ML — Frame length code (ML,SM,LK)
- 200 — Frame size
- IE4 M3JP — Products code (M3JP or IE4 M3JP etc.)

2. Safety considerations

The motor is intended for installation and use by qualified personnel, familiar with health and safety requirements and national legislation.

Safety equipment necessary for the prevention of accidents at the installation and operating site must be provided in accordance with local regulations.

WARNING!
Emergency stop controls must be equipped with restart lockouts. After emergency stop a new start command can take effect only after the restart lockout has been intentionally reset.

Points to be observed

1. Do not step on the motor.
2. The temperature of the outer casing of the motor may be hot to the touch during normal operation and especially after shut-down.
3. Some special motor applications may require additional instructions (e.g. when supplied with a frequency converter).
4. Observe rotating parts of the motor.
5. Do not open terminal boxes while energized.

NOTE!
Additional Warnings and/or Notes related to safe use can be found in other chapters of this manual.

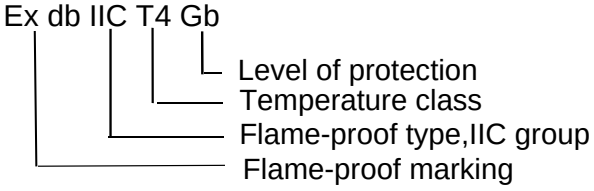
2.1 Motors in Group IIC and Group III

For motors in Group IIC and Group III which are certified according to IEC/EN60079-0 or GB/T 3836.1:

WARNING!
In order to minimize the risk of hazards caused by electrostatic charges, a motor may be cleaned only with a wet rag or by non-frictional means.

2.2 Flame-proof marking

Ex db IIB/IIC T4 Gb
Ex tb IIIB/IIIC T130℃/T135℃ Gb
Ex tc IIIB/IIIC T130℃/T135℃ Gc



2.3 The certificate numbers

International certificate numbers：
IE3 M3JP80-132: CNEX 21 ATEX 0002X
IECEx CNEX 21.0003X
IE3 M3JP160-355: CNEX 18 ATEX 0032X
IECEx CNEX 18.0041X
IE4 M3JP160-355: IECEx CNEX 23.0004X

2.4 Specific Conditions for Use:

2.4.1 Frame sizes 80-132

For IC411 cooling system, the ambient temperature range is limited to -20 °C … +60 °C.

For mounting conform IC416, the ambient temperature range is limited to -20℃...+40℃.

Some flameproof joints dimensions are lower than maximum defined in the table 2 and table 3 of IEC/EN 60079-1. These manufacturing gaps are defined in the manufacturer dismantling and assembly guide N°3GZF500708-104.

For VSD operation and for duty types other than S1, the motor temperature shall be monitored by resistance thermometers or PTC-thermistors in the stator windings. These devices have to be connected to suitable tripping units that have been functionally tested for this purpose.

For VSD operation, the manufacturer's instructions for machines fed from converters have to be respected. The minimum switching frequency is 3 kHz.

The instructions of the manufacturer to minimize the risk from electrostatic discharge must be strictly respected. The special fasteners of the flameproof enclosure shall have minimum quality class 8.8 (for carbon steel screws) and A4-80 (for stainless steel screws).

2.4.2 Frame sizes 160-355

For IC411 cooling system, the ambient temperature range is limited to -20 °C … +50 °C.

For VSD operation （5-100Hz）with IC416 cooling system, the ambient temperature range is limited to -20℃... +40℃.

The width of flameproof joints in the enclosure and in the bushings is more than the minimum values specified in the IEC 60079-1 standard. If needed, repair of the flameproof joints must be made in compliance with the structural specifications provided by the manufacturer. Repair of the threaded joints must be made in compliance with the specifications provided by the manufacturer. Repairs must not be made only on the basis of values specified in table 4 of IEC 60079-1:2014.

For VSD operation and for duty types other than S1, the motor temperature shall be monitored by resistance thermometers or PTC-thermistors in the stator windings. These devices have to be connected to suitable tripping units that have been functionally tested for this purpose.

For VSD operation, the manufacturer's instructions for machine fed from converters have to be respected. The following VSD operation
parameters must be complied with:

- switching frequency : ≥3 kHz （PWM）
- switching frequency: ≥ 2 kHz （DTC）
- Maximum peak voltage: 1300 V (standard insulation), 1800 V (special insulation)

All electrical connections shall be tightened with the tightening torques specified in the manufacturer's instructions.

Except as follows for the following 4 models, whenoperated at 690 V – 60 Hz:

- M3JP180MLA4 (18.5kW) and M3JP225SMA4 (37kW): -20 °C … +45 °C
- M3JP225SMB4 (45kW) and M3JP315SMC6 (75kW): -20 °C … +40 °C.

2.5 Maximum powers

Frame size	80	90	100	112	132	160	180	200	225	250	280	315	355
Power Max[kW]	1.1	2.2	3	4	7.5	18.5	22	37	45	55	90	250	355

3. Handling

3.1 Reception check

Immediately upon receipt, check the motor for external damage (e.g. shaft, -ends and flanges and painted surfaces) and, if found, inform the forwarding agent without delay.

Check all rating plate data, especially voltage, winding connections (star or delta), category, type of protection and temperature class. The type of bearing is specified on the rating plate of all motors except the smallest frame sizes.

In the case of a variable speed drive application, check the maximum loadability allowed according to the frequency stamped on the motor's second rating plate.

3.2 Transportation and storage

The motor should always be stored indoors (above –20 °C) in dry, vibration-free and dust-free conditions. During transportation, shocks, falls and humidity should be avoided. In other conditions, please contact ABB.

Unprotected machined surfaces (shaft-ends and flanges) should be treated against corrosion.

It is recommended that shafts are rotated periodically by hand to prevent grease migration.

Anti-condensation heaters, if fitted, are recommended to be energized to avoid water condensing in the motor.

The motor must not be subject to any external vibrations exceeding 0.5 mm/s at standstill so as to avoid causing damage to the bearings.

Motors fitted with cylindrical-roller and/or angular contact bearings must be fitted with locking devices during transport.

3.3 Lifting

All ABB motors above 25 kg are equipped with lifting lugs or eyebolts.

Only the main lifting lugs or eyebolts of the motor should be used for lifting the motor. They must not be used to lift the motor when it is attached to other equipment.

Lifting lugs for auxiliaries (e.g. brakes, separate cooling fans) or terminal boxes must not be used for lifting the motor.

Because of different frame lengths, mounting arrangements and auxiliary equipment, motors with the same frame may have a different center of gravity

Damaged lifting lugs must not be used. Check that eyebolts or integrated lifting lugs are undamaged before lifting.

Lifting eyebolts must be tightened before lifting. If needed, the position of the eyebolt can be adjusted using suitable washers as spacers.

Ensure that proper lifting equipment is used and that the sizes of the hooks are suitable for the lifting lugs.

Care must be taken not to damage auxiliary equipment and cables connected to the motor.

Remove eventual transport jigs fixing the motor to the pallet.

Specific lifting instructions are available from ABB.

WARNING!
During lifting, mounting or maintenance work, all necessary safety considerations shall be in place and special attention is to be taken so that nobody will be subject to lifted load.

3.4 Motor weight

The total motor weight can vary within the same frame size (center height) depending on different output, mounting arrangement and auxiliaries.

The following table shows the estimated maximum weights for motors in their basic versions as a function of their frame material.

The actual weight of all ABB's motors is shown on the rating plate.

Frame Size	**Aluminum** Max. weight kg	**Cast iron** Max. weight kg	**Flameproof** Max. weight kg
71	7	12	-
80	15	31	40
90	20	44	53
100	31	63	72
112	35	72	81
132	93	120	120
160	145	260	260
180	180	310	310
200	250	340	350
225	320	430	450
250	390	530	510
280	430	900	850
315	-	1600	1300
355	-	2600	3000
400	-	3500	3700
450	-	4800	5000

If the motor is equipped with a brake and/or separate fan, contact ABB for the weight.

4. Installation and commissioning

WARNING
Disconnect and lock out before working on the motor or the driven equipment. Ensure no explosive atmosphere is present while executing insulation resistance check procedures.

WARNING
The plastic plug must be replaced by Ex-approved cable entries when running the motor!

4.1 General

All rating plate values relating to certification must be carefully checked to ensure that the motor protection, atmosphere and zone are compatible.

Special attention should be paid to dust ignition temperature and dust layer thickness in relation to the motor's temperature marking.

Motors Motors requiring protective roof:
When fitted in a vertical position with the shaft pointing downwards, the motor must have a protective cover to prevent foreign objects and fluid from falling into the ventilation openings. This task can also be achieved by a separate cover not fixed to the motor. In this case, the motor must have a warning label.

4.2 Motors with other than ball bearings

Remove transport locking if employed. Turn the shaft of the motor by hand to check free rotation, if possible.

Motors equipped with roller bearings:
Running the motor with no radial force applied to the shaft may damage the roller bearing due to a "sliding" effect.

Motors equipped with angular contact bearing:
Running the motor with no axial force applied in the right direction in relation to the shaft may damage the angular contact bearing.

WARNING
For Ex d/Ex db and Ex de/Ex db ebmotors with angular contactbearings the axial force must not by any means change direction, because the flameproof gaps around the shaft change dimensions and may evencause contact!

The bearing types are specified on the rating plate.

Motors equipped with re-greasing nipples:
When starting the motor for the first time, or after long storage, apply the specified quantity of grease.

See section "7.2.2 Motors with re-greasing nipples" for more details.

4.3 Insulation resistance check

Measure insulation resistance before commissioning and when winding dampness is suspected.

Insulation resistance, corrected to 25 °C, may not in any cases be below 1 MΩ (measured with 500 or 1000 VDC). The insulation resistance value is halved for each 20°C increase in temperature.

Figure 1 can be used for the insulation correction to the desired temperature.

WARNING
To avoid risk of electrical shock, the motor frame must be grounded and the windings should be discharged against the frame immediately after each measurement.

If the reference resistance value is not attained, the winding is too damp and must be oven dried. The oven temperature should be 90 °C for 12-16 hours followed by 105 °C for 6-8 hours.

If fitted, drain plugs must be removed and closing valves must be opened during heating. After heating, make sure the drain plugs are refitted. Even if the drain plugs are fitted, it is recommended to disassemble the end shields and terminal box covers for the drying process.

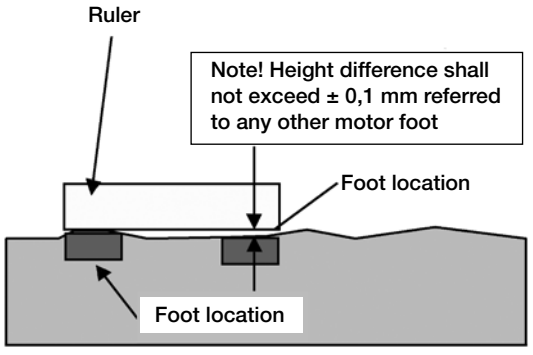
Windings drenched in seawater normally need to be rewound.

4.4 Foundation

The end user has full responsibility for the preparation of the foundation.

Metal foundations should be painted to avoid corrosion.

Foundations must be even, and sufficiently rigid to withstand possible short circuit forces. They must be designed and dimensioned to avoid the transfer of vibration to the motor and vibration caused by resonance. See figure below.



4.5 Balancing and fitting coupling halves and pulleys

As standard, balancing of the motor has been carried out using a half key.

Coupling halves or pulleys must be balanced after machining the keyways. Balancing must be done in accordance with the balancing method specified for the motor.

Coupling halves and pulleys must be fitted on the shaft by using suitable equipment and tools which do not damage the bearings and seals.

Never fit a coupling half or pulley by hammering or remove it by using a lever pressed against the body of the motor

4.6 Mounting and alignment of the motor

Ensure that there is enough space for free airflow around the motor. It is recommended to have a clearance between the fan cover and the wall etc. of at least ½ of the air intake of the fan cover. Additional information may be found from the product catalog or from the dimension drawings available on our web pages: www.abb.com/motors&generators.

Correct alignment is essential to avoid bearing, vibration and possible shaft failures.

Mount the motor on the foundation using the appropriate bolts or studs and place shim plates between the foundation and the feet.

Align the motor using appropriate methods.

If applicable, drill locating holes and fix the locating pins into position.

Mounting accuracy of a coupling half: check that clearance b is less than 0.05 mm and that the difference **a1** to **a2** is also less than 0.05 mm. See figure 2.

Re-check the alignment after the final tightening of the bolts or studs.

Do not exceed permissible loading values for bearings as stated in the product catalogs.

Check that the motor has sufficient airflow. Ensure that no nearby objects or direct sunshine radiate additional heat to the motor.

For flange mounted motors (e.g. B5, B35, V1), make sure that the construction allows sufficient air flow on the outer surface of the flange.

4.7 Radial forces and belt drives

Belts must be tightened according to the instructions of the supplier of the driven equipment. However, do not exceed the maximum belt forces (i.e. radial bearing loading) stated in the relevant product catalogs.

WARNING
Excessive belt tension will damage bearings and can cause shaft breakage. For Ex d/Ex db and Ex de/Ex db eb-motors excessive belt tension may even cause danger by eventual mutual contact of the flame path parts.

4.8 Motors with drain plugs for condensation

Check that drain holes and plugs face downwards. In vertical position mounted motors the drain plugs may be in horizontal position.

Increased safety motors
Motors with sealable plastic drain plugs are delivered with these in the closed position in aluminum motors and in the open position in cast iron motors. In clean environments, open the drain plugs before operating the motor. In very dusty environments, all drain holes should be closed.

Flameproof motors
Drain plugs, if requested, are located at the lower part of the end shields in order to allow condensation to escape from the motor. Open the drain plug by turning it counterclockwise, tap it to check free operation and close it by pressing and screwing it clockwise.

Dust Ignition Protection Motors
The drain holes must be closed on all dust ignition protection motors.

4.9 Cabling and electrical connections

The terminal box on standard single speed motors normally contains six winding terminals and at least one earth terminal.

In addition to the main winding and earthing terminals, the terminal box can also contain connections for thermistors, heating elements or other auxiliary devices.

Suitable cable lugs must be used for the connection of all main cables. Wiring for auxiliaries can be connected into their terminal blocks as such.

Motors are intended for fixed installation only. Unless otherwise specified, cable entry threads are metric. The protection class and the IP-class of the cable gland must be at least the same as those of the terminal boxes.

Ensure only certified cable glands for increased safety and flameproof motors are used. For non-sparking motors, cable glands must comply with IEC/EN 60079-0. For Ex tD/Ex t motors, cable glands must comply with IEC/EN 60079-0 and IEC/EN 60079-31.

NOTE!
Cables should be mechanically protected and clamped close to the terminal box to fulfill the appropriate requirements of IEC/EN 60079-0 and local installation standards.

Unused cable entries must be closed with blanking elements according to the protection and IP class of the terminal box.

The degree of protection and diameter are specified in the documents relating to the cable gland.

WARNING
Use appropriate cable glands and seals in the cable entries according to the protection type and the type and diameter of the cable.

Earthing must be carried out according to local regulations before the machine is connected to the supply voltage.

The earth terminal on the frame has to be connected to PE (protective earth) with a cable as shown in Table 5 of IEC/EN 60034-1:

Minimum cross-sectional area for protective conductors

Cross-sectional area of phase conductors of the installation, S, mm^2	Minimum cross-sectional area of the corresponding protective conductor, S_P, mm^2
4	4
6	6
10	10
16	16
25	25
35	25
50	25
70	35
95	50
120	70
150	70
185	95
240	120
300	150
400	185

In addition, earthing or bonding connection facilities on the outside of an electrical apparatus must provide an effective connection of a conductor with a cross-sectional area of at least 4 mm^2.

The cable connection between the network and motor terminals must meet the requirements stated in the national standards for installation or in the standard IEC/EN 60204-1 according to the rated current indicated on the rating plate.

NOTE!
– For motors with frame sizes less than 225, cables having a permissible operating temperature of +90 °C as minimum shall be used.
– Suitable heat-resisting cables rated minimum +110 °C must be applied for motor frame sizes 225 and above.
– All other conversion factors depending on the installation conditions shall be taken into account while sizing the cables.

Ensure that the motor protection corresponds to the environment and weather conditions.

The seals of terminal boxes (other than Ex d/Ex db) must beplaced correctly in the slots provided, to ensure the correct IP class. A leak could lead to penetration of dust or water, creating a risk of flashover to live elements. If seals or gaskets are replaced, original sealing solution materials must be used.

4.9.1 Flameproof motors

There is type of protection for the terminal box:

– Ex db for M3JP-motors and IE4 M3JP

Certain cable glands are approved for a maximum amount of free space in the terminal box. The amount of free space for the motor range and the number and type of gland threads are listed below.

Motor type **M3JP / IE4 M3JP**	Pole number	Terminal box type	Threaded holes	Terminal box free volume	Cover bolt size	Tightening torque of terminal box bolts
80 – 90	2 – 8	25	1xM25	1.0 dm^3	M8	23 Nm
100 – 132	2 – 8	25	2xM32	1.0 dm^3	M8	23 Nm
160 – 180	2 – 8	63	2xM40	4.0 dm^3	M10	46 Nm
200 – 250	2 – 8	160	2xM50	10.5 dm^3	M10	46 Nm
280	2 – 8	210	2xM63	24 dm^3	M8	23 Nm
315	2 – 8	370	2xM75	24 dm^3	M8	23 Nm
355	2 – 8	750	2xM75	79 dm^3	M12	80 Nm
400 – 450	2 – 8	750	2xM75	79 dm^3	M12	80 Nm

Auxiliary cable entries

Motor type	Pole number	Threaded holes
80 – 132	2 – 8	1xM20
160 – 450	2 – 8	2xM20

When closing the terminal box cover ensure that no dust has settled on the surface gaps. Clean and grease the surface with non-hardening contacting grease.

WARNING
Do not open the motor or the terminal box while the motor is still warm and energized when an explosive atmosphere is present.

4.9.2 Dust ignition protection motors Ex t

As standard, motors have the terminal box fitted on the top with a cable entry possible from both sides. A full description is contained in the product catalogs.

Pay special attention to the sealing of the terminal box and cables to prevent the access of combustible dust into the terminal box. It is important to check that the external sealing is in good condition and well placed because they can be damaged or moved during handling.

When closing the terminal box cover, ensure that no dust has settled on the surface gaps and check that the sealing is in good condition – if not, it has to be replaced with an identical seal.

WARNING
Do not open the motor or the terminal box while the motor is still warm and energized when an explosive atmosphere is present.

4.9.3 Connections for different starting methods

The terminal box on single speed motors normally contains a terminal block with six winding terminals and at least one separate earth terminal. This enables the use of DOL- or Y/D -starting. See Figure 3.
For two-speed and special motors, the terminal connection must follow the instructions inside the terminal box or in the motor manual.
The voltage and connection are stamped on the rating plate.

Direct-on-line starting (DOL):
Y or D winding connections may be used.

For example, 690 VY, 400 VD indicates Y-connection for 690 V and D-connection for 400 V.

Star/Delta (Wye/Delta) starting (Y/D):
The supply voltage of the motor must be equal to the rated voltage when using a D-connection.
Remove all connection straps from the terminal block.
For increased safety motors (Ex e/Ex eb), both direct-on-line andstar-delta starting of motors are allowed. In the case of
star-delta starting, only Ex-approved equipment is allowed.

Other starting methods and severe starting conditions:
In the case where other starting methods (e.g. converter or soft starter) will be used in the duty types of S1 and S2, it is considered that the device is “isolated from the power system when the electrical machine is running” as in the standard IEC 60079-0 and thermal protection is optional.

4.9.4 Connections of auxiliaries

If a motor is equipped with thermistors or other RTDs (Pt100, thermal relays, etc.) and auxiliary devices, it is recommended they are used and connected by appropriate means. For certain applications, it is mandatory to use thermal protection. More detailed information can be found in the documents delivered with the motor. Connection diagrams for auxiliary elements and connection parts can be found inside the terminal box.

The maximum measuring voltage for the thermistors is 2.5 V. The maximum measuring current for Pt100 is 5 mA. Using a higher measuring voltage or current may cause errors in readings or a damaged temperature detector.

The insulation of thermal sensors fulfills the requirements of basic insulation.

4.10 Terminals and direction of rotation

The shaft rotates clockwise when viewing the shaft face at the motor drive end, and the line phase sequence – L1, L2, L3 – is connected to the terminals as shown in figure 3.

To alter the direction of rotation, interchange any two connections on the supply cables.

If the motor has a unidirectional fan, ensure that it rotates in the same direction as the arrow marked on the motor.

4.11 Protection against overload and stalling

All motors for explosive atmospheres must be protected against overloads, see installation standards IEC/EN 60079-14 and local installation requirements.

For increased safety motors (Ex e/Ex eb), the maximum trippingtime for protective devices must not be longer than thetime t_E shown on the motor rating plate.

For Ex ec- and Ex t -type of motors, no additional safety devices above normal industrial protection(s) are required.

5. Operation

5.1 General

The motors are designed for the following conditions unless otherwise stated on the rating plate:

– Motors are to be installed in fixed installations only.
– Normal ambient temperature range is from –20 °C to +50 °C.
– Maximum altitude is 1000 m above sea level.
– The variation of the supply voltage and frequency may not exceed the limits mentioned in relevant standards. Tolerance for supply voltage is ±5 %, and for frequency ±2 % according to Figure 4 (EN / IEC 60034-1, paragraph 7.3, Zone A). Both extreme values are not supposed to occur at the same time.

The motor can only be used in applications for which it is intended. The rated nominal values and operational conditions are shown on the motor rating plates. In addition, all requirements of this manual and other related instructions and standards must be followed.

If these limits are exceeded, motor data and construction data must be checked. Please contact ABB for further information.

Particular attention must be paid to corrosive atmospheres when using flameproof motors; ensure that the paint protection is suitable for the ambient conditions as corrosion can damage the explosion-proof enclosure.

WARNING!
Ignoring any instructions or maintenance of the apparatus may jeopardize safety and thus prevent the use of the machine in explosive atmospheres.

6. Motors for explosive atmospheres and variable speed operation

6.1 Introduction

This part of the manual provides additional instructions for motors, later Ex motors, used in explosive atmospheres in a frequency converter supply. Ex motor is intended to operate from a single frequency converter supply and not motors running in parallel from one frequency converter. In addition to these instructions in this manual, additional instructions provided by the converter manufacturer shall be followed.

ABB manufactured Ex motors; Ex ec, Ex t, Ex d/ Ex db and Ex de/Ex db eb have been type tested with ACS800/ ACS880 converters in DTC control and ACS550 converters, so these combi-nations can be selected using the dimensioning instruc-tions provided in Chapter 6.8.2. The minimum switchingfrequency is 3 kHz for all type of Ex motors and is the basis for the dimensioning guidelines in the followingchapters.

6.2 Main requirements according to EN and IEC standards

Flameproof motors Ex d/Ex db, Ex de/Ex db eb
The motor must be dimensioned so that the maximum surface temperature of the motor is limited according to the temperature or temperature class. In most cases, this requires either type tests or controlling the surface temperature of the motor.

If the temperature class T5 or T6 for Ex d/Ex db or Ex de/ Ex db eb motor is requested, please contact your local sales office forassistance.

In case of other voltage source converters with pulse width modulation type of control (PWM), combined tests are usually needed to confirm the correct thermal performance of the motor. These tests can be avoided if flameproof motors are equipped with thermal sensors intended for control of surface temperatures. Such motors have the following additional markings on the rating plate: – “PTC” with the tripping temperature and “DIN 44081/82”.

Increased safety motors Ex e/Ex eb
ABB does not recommend the use of random wound low voltage increased safety motors with variable speed drives. This manual does not cover these motors in variable speed drives.

Increased safety motors Ex nA/Ex ec
The combination of a motor and converter must be tested as a unit or dimensioned by calculation.

In case of other voltage source PWM converters with a minimum switching frequency of 3 kHz or higher, preliminary dimensioning instructions provided in Chapter 6.8.3 in this manual can be used. The final values must be verified by combined tests.

Dust ignition protection motors, Ex t (Ex tD)
The motor must be dimensioned so that the maximum outer surface temperature of the motor is limited according to the temperature class (e.g. T125 ºC or T150 ºC). For more information on a temperature class lower than 125 °C, please contact ABB.

In case of other voltage source converters with pulse width modulation type of control (PWM), combined tests are usually needed to confirm the correct thermal performance of the motor. These tests can be avoided if Ex t motors are equipped with thermal sensors intended for control of the surface temperatures. Such motors have the following additional markings on the rating plate: – “PTC” with the tripping temperature and “DIN 44081/82”.

In case of voltage source PWM converters with a minimum switching frequency of 3 kHz or higher, instructions provided in Chapter 6.8.3 can be used for preliminary dimensioning.

6.3 Winding insulation

6.3.1 Phase to phase voltages

The maximum allowed phase to phase voltage peaks on the motor terminal as a function of the rise time of the pulse is shown in Figure 5.

The highest curve “ABB Special Insulation” (variant code 405) applies to motors with a special winding insulation for a frequency converter supply.

The “ABB Standard Insulation” applies to all other motors covered by this manual.

6.3.2 Phase to ground voltages

The allowed phase to ground voltage peaks at motor terminals are:

- Standard Insulation 1300 V peak
- Special Insulation 1800 V peak

6.3.3 Selection of winding insulation with frequency converters

The selection of winding insulation and filters can be made according to table below:

Nominal supply voltage U_N of the converter	Winding insulation and filters required
$U_N \leq 500$ V	ABB Standard insulation
$U_N \leq 600$ V	ABB Standard insulation + dU/dt filters OR ABB Special insulation (variant code 405)
$U_N \leq 690$ V	ABB Special insulation (variant code 405) AND dU/dt-filters at converter output

6.4 Thermal protection of windings

All cast iron Ex -motors are equipped with PTC thermistors to prevent the winding temperatures exceeding the thermal limits of used insulation system. In all cases it is recommended to connect them.

NOTE!
If not otherwise indicated on the rating plate, these thermistors do not prevent motor surface temperatures exceeding their temperature classes (T4 or T5).

ATEX-countries:
If the motor certificate requires, the thermistors must be connected to a thermistor circuit relay functioning independently and that is dedicated to reliably trip off the supply to the motor according to the requirements of the "Essential Health and Safety Requirements" in Annex II, item 1.5.1 of the ATEX Directive 94/9/EC or 2014/34/EU.

Non-ATEX countries:
It is recommended that the thermistors are connected to a thermistor circuit relay functioning independently and that is dedicated to reliably trip off the supply to the motor.

NOTE!
According to the local installation rules, it may be possible to also connect the thermistors to equipment other than a thermistor relay; for example, to the control inputs of a frequency converter.

6.5 Bearing currents

Bearing voltages and currents must be avoided in all variable speed applications to ensure the reliability and safety of the application. For this purpose, insulated bearings or bearing constructions, common mode filters and suitable cabling and grounding methods (see chapter 6.6) must be used.

6.5.1 Elimination of bearing currents

The following methods must be used to avoid harmful bearing currents in frequency converter driven motors:

Frame size	
250 and smaller	No actions needed
280 – 315	Insulated non-drive end bearing
355 – 450	Insulated non-drive end bearing AND Common mode filter at the converter

For the exact type of bearing insulation, see the motor's rating plate. Changing the bearing type or insulation method without ABB's permission is prohibited.

6.6 Cabling, grounding and EMC

To provide proper grounding and to ensure compliance with any applicable EMC requirements, motors above 30 kW must be cabled using shielded symmetrical cables and EMC glands, i.e. cable glands providing 360° bonding. Also for smaller motors, symmetrical and shielded cables are highly recommended. Make the 360° grounding arrangement at all cable entries as described in the instructions for the glands. Twist the cable shields into bundles and connect to the nearest ground terminal/ busbar inside the terminal box, converter cabinet, etc.

NOTE!
Proper cable glands providing 360° bonding must be used at all termination points, e.g. at motor, converter, possible safety switch, etc.

For motors of frame size IEC 280 and upward, additional potential equalization between the motor frame and the driven equipment is needed, unless both are mounted on a common steel base. In this case, the high frequency conductivity of the connection provided by the steel base should be checked by, for example, measuring the potential difference between the components.

More information about grounding and cabling of variable speed drives can be found in the manual "Grounding and cabling of the drive system" (Code: 3AFY 61201998) and material on fulfilling the EMC requirements can be found in respective converter manuals.

6.7 Load and speed limitations

6.7.1 General

NOTE!
The maximum speed of the motor must not be exceeded even if the loadability curves are given up to 100 Hz.

6.7.2 Motor loadability with ACS800/880-series of converters with DTC-control

The loadability curves (or load capacity curves) presented in Figures 6 , 7 and 8 show the maximum allowed continuousoutput torque of the motors as a function of supplyfrequency. The output torque is given as a percentage ofthe nominal torque of the motor.

6.7.3 Motor loadability with ACS550/580 –series and other voltage source converters

The loadability curves (or load capacity curves) presented in Figures 9 and 10 show the maximum allowed continuous output torque of the motors as a function of supply frequency. The output torque is given as a percentage of the nominal torque of the motor.

NOTE!
The loadability curves in Figures 9 and 10 are based on 3 kHz switching frequency.

For constant torque applications, the lowest allowed continuous operating frequency is 15 Hz.

For quadratic torque applications, the lowest continuous operating frequency is 5 Hz.

The combination of other voltage source converters than the ACS 500 –series must either be tested or thermal sensors to control the surface temperatures must be connected.

6.7.4 Short time overloads

ABB flameproof motors usually provide a possibility for short time overloading. For exact values, please see the motor's rating plate or contact ABB.

Overloadability is specified by three factors:

I_{OL} Maximum short time current
T_{OL} The length of allowed overload period
T_{COOL} Cooling time required after each overload period. During the cooling period motor current and torque must stay below the limit of allowed continuous loadability.

6.8 Rating plates

A VSD plate is mandatory for variable speed operation and shall contain the necessary data to define the allowed duty range in variable speed operation. At least the following parameters must be shown on the rating plates of motors for explosive atmospheres intended for variable speed operation:

– Duty type
– Type of load (constant or quadratic)
– Type of converter and minimum switching frequency
– Power or torque limitation
– Speed or frequency limitation

6.8.1 Content of standard VSD plate

The standard VSD plate, contains followinginformation:

- Supply voltage or voltage range (VALID FOR) and supply frequency (FWP) of the drive
- Motor type
- Minimum switching frequency for PWM converters (MIN. SWITCHING FREQ. FOR PWM CONV.)
- Limits for short time overloads (I OL, T OL, T COOL), see chapter 6.7.4
- Allowed load torque for DTC controlled ACS800/880 converters (DTC-CONTROL). The load torque is provided as percent of the nominal torque of the motor.
- Allowed load torque for PWM controlled ACS550/580 converters (PWM-CONTROL). The load torque is provided as percent of the nominal torque of themotor. See also chapter 6.7.3.

The standard VSD plate requires calculation by the customer to convert the generic data into motor specific data. The hazardous motor catalogue will be required to convert the frequency limits to speed limits, and the torque limits into current limits. Customer specific plates can be requested from ABB if preferred.

6.8.2 Content of customer specific VSD plate

Customer specific VSD plates, containapplication and motor specific data for variable speedapplication as follows:

- Motor type
- Motor serial number
- Frequency converter type (FC Type)
- Switching frequency (Switc. freq.)
- Field weakening or nominal point of the motor (F.W.P.)
- List of specific duty points
- Type of load (CONSTANT TORQUE, QUADRATIC TORQUE, etc.)
- Speed range
- If the motor is equipped with thermal sensors suitable for direct thermal control, a text "PTC xxx C DIN44081/-82", where "xxx" denotes the tripping temperature of the sensors.

In customer specific VSD plates, the values are for the specific motor and application. The duty point values can in most cases be used for programming the converters' protective functions as such.

6.9 Commissioning the variable speed application

The commissioning of the variable speed application must be done according to the instructions provided in this manual, in the respective frequency converter manuals and local laws and regulations. The requirements and limitations set by the application must also be taken into account.

The most often needed parameters to set up the converter are:

– Motor nominal
  - voltage
  - current
  - frequency
  - speed
  - power

These parameters may be taken from a single line of the standard rating plate fixed on the motor.

NOTE!
In the case of missing or inaccurate information, do not operate the motor before ensuring correct settings!

It is recommended to use all suitable protective features provided by the converter to improve the safety of the application. Converters usually provide features such as:

– Minimum speed
– Maximum speed
– Stall protection
– Acceleration and deceleration times
– Maximum current
– Maximum power
– Maximum torque
– User load curve

WARNING
These features are only additional and do not replace the safety functions required by local safety regulations or standards.

6.9.1 Setting parameters based on the VSD plate

Check that the VSD plate is valid for the application in question, i.e. that the supply network corresponds to the data of “FWP” and that the requirements set for the converter are met (type and control type of the converter, as well as the switching frequency)

Check that the load complies with allowed loading for the converter in use.

Feed in the basic start-up data. The basic start-up data needed in converters shall be taken from a rating plate. Detailed instructions areavailable in the manuals of respective frequency convert-ers.

In case of converters supplied by ABB, e.g. ACS800, ACS880, ACS550 etc., all parameter settings can be found from the respective manuals. In all frequency converters, at least the following parameter settings influence motor temperatures; minimum switching frequency, preventing over modulation at and above the field weakening point must be checked.

7. Maintenance

WARNING
Voltage may be connected at standstill inside the terminal box for heating elements or direct winding heating.

WARNING
Standards IEC/EN 60079-17 and -19 relating to repair and maintenance of electrical apparatus in explosive atmospheres must be taken into consideration. Only competent personnel acquainted with these standards should handle this type of apparatus.

Depending on the nature of the work in question, disconnect and lock out before working on motor or driven equipment. Ensure no explosive gas or dust is present while work is in progress.

IEC/EN 60079-17 is not applicable for M3JM and M3KM motors.

7.1 General inspection

1. For inspection and maintenance, use standards IEC/EN 60079-17 (especially tables 1-4) as a guideline.
2. Inspect the motor at regular intervals. The frequency of checks depends on, for example, the humidity level of the ambient air and on the local weather conditions. This can initially be determined experimentally and must then be strictly adhered to.
3. Keep the motor clean and ensure free ventilation airflow. If the motor is used in a dusty environment, the ventilation system must be regularly checked and cleaned.
4. Check the condition of shaft seals (e.g. V-ring or radial seal) and replace if necessary.
5. For Ex t motors, carry out a detailed inspection according to IEC/EN 60079-17 table 4 with a recommended interval of 2 years or 8,000 h.
6. Check the condition of the connections, and mounting and assembly bolts.
7. Check the bearing condition by listening for any unusual noise, vibration measurement, bearing temperature, inspection of spent grease or SPM bearing monitoring. Pay special attention to bearings when their calculated rated life time is coming to an end.

When signs of wear are noticed, dismantle the motor, check the parts and replace if necessary. When bearings are changed, replacement bearings must be of the same type as those originally fitted. The shaft seals have to be replaced with seals of the same quality and characteristics as the originals when changing the bearings.

For flameproof motors, periodically open the drain plug, if equipped, by turning it counterclockwise, tap it to check free operation and close it by pressing and screwing it clockwise. This operation must be done when the motor is at standstill. The frequency of checks depends on the humidity level of the ambient air and on the local weather conditions. This can initially be determined experimentally and must then be strictly adhered to.

In the case of the IP 55 motor and when the motor has been delivered with a plug closed, it is advisable to periodically open the drain plugs in order to ensure that the way out for condensation is not blocked and allows condensation to escape from the motor. This operation must be done when the motor is at a standstill and has been made safe to work on

7.1.1 Standby motors

If the motor is in standby for a longer period of time on a ship or in other vibrating environment the following measures have to be taken:

1. The shaft must be rotated regularly every 2 weeks (to be reported) by means of starting of the system. In case a startup is not possible, for any reason, at least the shaft has to be turned by hand in order to achieve a different position once a week. Vibrations caused by other vessel equipment will cause bearing pitting which should be minimized by regular operation/hand turning.
2. The bearing must be greased while rotating the shaft every year (to be reported). If the motor has been provided with roller bearing at the driven end, the transport lock must be removed before rotating the shaft. The transport locking must be remounted in case of transportation.
3. All vibrations must be avoided to prevent a bearing from failing. All instructions in the motor instruction manual for commissioning and maintenance have to be followed. The warranty will not cover the winding and bearing damages if these instructions have not been followed.

7.2 Lubrication

WARNING
Beware of all rotating parts.

WARNING
Grease can cause skin irritation and eye inflammation. Follow all safety precautions specified by the manufacturer of the grease.

Bearing types are specified in the respective product catalogs and on the rating plate of all motors except smaller frame sizes.

Reliability is a vital issue for bearing lubrication intervals. ABB uses the L1-principle (i.e. that 99 % of the motors are certain to make the life time) for lubrication.

7.2.1 Motors with permanently greased bearings

Bearings are usually permanently greased bearings of 1Z, 2Z, 2RS or equivalent.

As a guide, adequate lubrication for sizes up to 250 can be achieved for the following duration, according to L_1. For duties with higher ambient temperatures, please contact ABB. The informative formula to change the L_1 values roughly to L_{10} values: $L_{10} = 2.7 \times L_1$.

Duty hours for permanently greased bearings at ambient temperatures of 25 °C and 40 °C are:

Frame size	Poles	Duty hours at 25 °C	Duty hours at 40 °C
71	2	67 000	42 000
71	4 – 8	100 000	56 000
80-90	2	100 000	65 000
80-90	4 – 8	100 000	96 000
100-112	2	89 000	56 000
100-112	4 – 8	100 000	89 000
132	2	67 000	42 000
132	4 – 8	100 000	77 000
160	2	60 000	38 000
160	4 – 8	100 000	74 000
180	2	55 000	34 000
180	4 – 8	100 000	70 000
200	2	41 000	25 000
200	4 – 8	95 000	60 000
225	2	36 000	23 000
225	4 – 8	88 000	56 000
250	2	31 000	20 000
250	4 – 8	80 000	50 000

Data is valid up to 60 Hz.

7.2.2 Motors with re-greasable bearings

Lubrication information plate and general lubrication advice
If the machine is equipped with a lubrication information plate, follow the given values.

Greasing intervals regarding mounting, ambient temperature and rotational speed are defined on the lubrication information plate.

During the first start or after a bearing lubrication, a temporary temperature rise may appear, approximately 10 to 20 hours.

Some motors may be equipped with a collector for old grease. Follow the special instructions given for the equipment.

After re-greasing a Ex t motor, clean the motor end shields so they are free of any dust layer.

A. Manual lubrication

Re-greasing while the motor is running
– Remove grease outlet plug or open closing valve if fitted.
– Be sure that the lubrication channel is open
– Inject the specified amount of grease into the bearing.
– Let the motor run for 1-2 hours to ensure that all excess grease is forced out of the bearing. Close the grease outlet plug or closing valve if fitted.

Regreasing while the motor is at a standstill
If it is not possible to re-grease the bearings while the motors are running, lubrication can be carried out while the machine is at a standstill.
– In this case use only half the quantity of grease and then run the motor for a few minutes at full speed.
– When the motor has stopped, apply the rest of the specified amount of grease to the bearing.
– After 1–2 running hours, close the grease outlet plug or closing valve if fitted.

B. Automatic lubrication
The grease outlet plug must be removed permanently with automatic lubrication or open closing valve if fitted.

ABB recommends only the use of electromechanical systems.

The amount of grease per lubrication interval stated in the table should be multiplied by three if a central lubrication system is used. When using a smaller automatic re-grease unit (one or two cartridges per motor) the normal amount of grease can be used.

When 2-pole motors are automatically re-greased, the note concerning lubricant recommendations for 2-pole motors in the Lubricants chapter should be followed.

The used grease should be suitable for automatic lubrication. The automatic lubrication system deliverer and the grease manufacturer's recommendations should be checked.

Calculation example of amount of grease for automatic lubrication system
Central lubrication system: Motor IEC M3_P 315_ 4-pole in 50 Hz network, re-lubrication interval according to table below is 7600 h/55 g (DE) and 7600 h/40g (NDE):

(DE) RLI = 55 g/7600h*3*24 = 0,52 g/day
(NDE) RLI = 40 g/7600h*3*24 = 0,38 g/day

Calculation example of amount of grease for single automation lubrication unit (cartridge)
(DE) RLI = 55 g/7600 h*24 = 0,17 g/day
(NDE) RLI = 40 g/7600 h*24 = 0,13 g/day

RLI = Re-lubricaion interval, DE = Drive end, NDE = Non drive end

7.2.3 Lubrication intervals and amounts

Lubrication intervals for vertical machines are half of the values shown in the table below.

As a guide, adequate lubrication can be achieved for the following duration, according to L1. For duties with higher ambient temperatures please contact ABB. The informative formula to change the L1 values roughly to L10 values is: L10 = 2.0 x L1 with manual lubrication

The lubrication intervals are based on a bearing operating temperature of 80 °C (ambient temperature +25 °C).

NOTE!
An increase in the ambient temperature raises the temperature of the bearings correspondingly. The interval values should be halved for a 15 °C increase in bearing temperature and may be doubled for a 15 °C decrease in bearing temperature.

Higher speed operation, e.g. in frequency converter applications, or lower speed with heavy load will require shorter lubrication intervals.

WARNING
The maximum operating temperature of the grease and bearings, +110°C, must not be exceeded.

The designed maximum speed of the motor must not be exceeded.

Ball bearings

Frame size	Amountof grease DE-bearing [g]	Amount of grease NDE-bearing [g]	3600 r/min	3000 r/min	1800 r/min	1500 r/min	1000 r/min	500-900 r/min
			Lubrication intervals in duty hours					
160	13	13	7 100	8 900	14 300	16 300	20 500	21 600
180	15	15	6 100	7 800	13 100	15 100	19 400	20 500
200	20	15	4 300	5 900	11 000	13 000	17 300	18 400
225	23	20	3 600	5 100	10 100	12 000	16 400	17 500
250	30	23	2 400	3 700	8 500	10 400	14 700	15 800
280	35	35	1 900	3 200	–	–	–	–
280	40	40	–	–	7 800	9 600	13 900	15 000
315	35	35	1 900	3 200	–	–	–	–
315	55	40	–	–	5 900	7 600	11 800	12 900
355	35	35	1 900	3 200	–	–	–	–
355	70	40	–	–	4 000	5 600	9 600	10 700
400	40	40	1 500	2 700	–	–	–	–
400	85	55	–	–	3 200	4 700	8 600	9 700
450	40	40	1 500	2 700	–	–	–	–
450	95	70	–	–	2 500	3 900	7 700	8 700

Roller bearings

Frame size	Amountof grease DE-bearing [g]	Amount of grease NDE-bearing [g]	3600 r/min	3000 r/min	1800 r/min	1500 r/min	1000 r/min	500-900 r/min
			Lubrication intervals in duty hours					
160	13	13	3 600	4 500	7 200	8 100	10 300	10 800
180	15	15	3 000	3 900	6 600	7 500	9 700	10 200
200	20	15	2 100	3 000	5 500	6 500	8 600	9 200
225	23	20	1 800	1 600	5 100	6 000	8 200	8 700
250	30	23	1 200	1 900	4 200	5 200	7 300	7 900
280	35	35	900	1 600	–	–	–	–
280	40	40	–	–	4 000	5 300	7 000	8 500
315	35	35	900	1 600	–	–	–	–
315	55	40	–	–	2 900	3 800	5 900	6 500
355	35	35	900	1 600	–	–	–	–
355	70	40	–	–	2 000	2 800	4 800	5 400
400	40	40	–	1300	–	–	–	–
400	85	55	–	–	1 600	2 400	4 300	4 800
450	40	40	–	1 300	–	–	–	–
450	95	70	–	–	1 300	2 000	3 800	4 400

7.2.4 Lubricants

WARNING
Do not mix different types of grease.
Incompatible lubricants may cause bearing damage.

When regreasing, use only special ball bearing grease with the following properties:

– good quality grease with lithium complex soap and with mineral- or PAO-oil
– base oil viscosity 100-160 cST at 40 °C
– consistency NLGI grade 1.5 – 3 *)
– temperature range –30 °C – +140 °C, continuously.

*) A stiffer end of scale is recommended for vertical mounted motors or in hot conditions..

The above mentioned grease specification is valid if the ambient temperature is above –30 °C or below +55 °C, and the bearing temperature is below 110 °C, otherwise consult ABB regarding suitable grease.

Grease with the correct properties is available from all major lubricant manufacturers.

Admixtures are recommended, but a written guarantee must be obtained from the lubricant manufacturer, especially concerning EP admixtures, that admixtures do not damage bearings or the properties of lubricants at the operating temperature range.

WARNING
Lubricants containing EP admixtures are not recommended in high bearing temperatures in frame sizes 280 to 450.

The following high performance greases can be used:

– Mobil Unirex N2 or N3 (lithium complex base)
– Mobil Mobilith SHC 100 (lithium complex base)
– Shell Gadus S5 V 100 2 (lithium complex base)
– Klüber Klüberplex BEM 41-132 (special lithium base)
– FAG Arcanol TEMP110 (lithium complex base)
– Lubcon Turmogrease L 802 EP PLUS (special lithium base)
– Total Multiplex S2 A (lithium complex base)
– Rhenus Rhenus LKZ 2 (lithium complex base)

NOTE!
Always use high speed grease for high speed 2-pole machines where the speed factor is higher than 480,000 (calculated as Dm x n where Dm = average bearing diameter, mm; n = rotational speed, r/min).

The following greases can be used for high speed cast iron motors but not mixed with lithium complex greases:

– Klüber Klüber Quiet BQH 72-102 (polyurea base)
– Lubcon Turmogrease PU703 (polyurea base)

If other lubricants are used, check with the manufacturer that the qualities correspond to those of the above mentioned lubricants. The lubrication intervals are based on the listed high performance greases above. Using other greases can reduce the interval.

8. After Sales support

8.1 Spare parts

Unless otherwise stated, spare parts must be original parts or approved by ABB.

Requirements in standard IEC/EN 60079-19 must be followed.

When ordering spare parts, the motor's serial number, full type designation and product code, as stated on the rating plate, must be specified.

8.2 Dismantling, re-assembly and rewinding

Follow the instructions given in standard IEC/EN 60079-19 regarding dismantling, re-assembly and rewinding. **Any operation must be undertaken by the manufacturer, i.e. ABB, or by an ABB authorized repair partner.**

No manufacturing alterations are permitted on the parts that make up the explosion-proof enclosure and the parts that ensure dust-tight protection. Also ensure that the ventilation is never obstructed.

Rewinding must always be carried out by an ABB authorized repair partner.

8.3 Bearings

Special care should be taken with the bearings.

These must be removed using pullers and fitted by heating or using special tools.

Bearing replacement is described in detail in a separate instruction leaflet available from the ABB Sales Office. Special recommendations apply when changing the bearings of dust ignition protection Ex t-motors (as the seals should be changed at the same time).

Any directions placed on the motor, such as labels, must be followed. The bearing types indicated on the rating plate must not be changed.

NOTE!
Any repair by the end user, unless expressly approved by the manufacturer, releases the manufacturer from responsibility to conformity.

8.4 Gaskets and sealing

Terminal boxes others than Ex d boxes are equipped with tested and approved sealing. When gaskets and/or sealing need to be renewed, they have to be replaced by original spare parts.

8.5 Maintenance of flameproof joint surface

When the explosion-proof joint surface needs to be repaired, the manufacturer must be contacted and the repair must be carried out according to their specified explosion-proof joint surface size.

9. Environmental requirements

Most of ABB's motors have a sound pressure level not exceeding 82 dB(A) (± 3 dB) at 50 Hz.

Values for specific machines can be found in the relevant product catalogs. At 60 Hz, sinusoidal supply the values are approximately 4 dB(A) higher compared to 50 Hz values stated in the product catalogs.

For sound pressure levels at frequency converter supplies, please contact ABB.

When motor(s) need to be scrapped or recycled, appropriate means, local regulations and laws must be followed.

10. Troubleshooting

These instructions do not cover all details or variations in equipment nor provide information for every possible condition to be met in connection with installation, operation or maintenance. Should additional information be required, please contact the nearest ABB Sales Office.

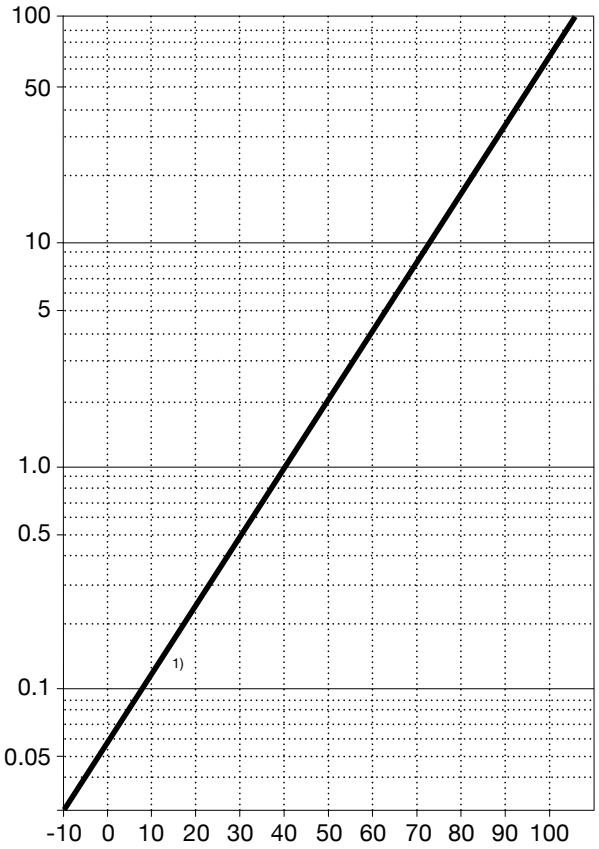
Motor troubleshooting chart
Your motor service and any troubleshooting must be handled by qualified persons who have the proper tools and equipment.

TROUBLE	CAUSE	WHAT TO DO
Motor fails to start	Blown fuses	Replace fuses with proper type and rating.
	Overload trips	Check and reset overload in starter.
	Improper power supply	Check to see that power supplied agrees with motor rating plate and load factor.
	Improper line connections	Check connections against diagram supplied with motor.
	Open circuit in winding or control switch	Indicated by humming sound when switch is closed. Check for loose wiring connections and ensure that all control contacts are closing.
	Mechanical failure	Check to see if motor and drive turn freely. Check bearings and lubrication.
	Short circuited stator Poor stator coil connection	Indicated by blown fuses. Motor must be rewound. Remove end shields and locate fault.
	Rotor defective	Look for broken bars or end rings.
	Motor may be overloaded	Reduce load.
Motor stalls	One phase may be open	Check lines for open phase.
	Wrong application	Change type or size. Consult equipment supplier.
	Overload	Reduce load.
	Low voltage	Ensure the rating plate voltage is maintained. Check connection.
	Open circuit	Fuses blown. Check the overload relay, stator and push buttons.
Motor runs and then dies down	Power failure	Check for loose connections to line, fuses and control.
Motor does not accelerate up to nominal speed	Not applied properly	Consult equipment supplier for proper type.
	Voltage too low at motor terminals because of line drop	Use higher voltage or transformer terminals or reduce load. Check connections. Check conductors for proper size.
	Starting load too high	Check the motor's starts against "no load".
	Broken rotor bars or loose rotor	Look for cracks near the rings. A new rotor may be required as repairs are usually temporary.
	Open primary circuit	Locate fault with testing device and repair.

TROUBLE	CAUSE	WHAT TO DO
Motor takes too long to accelerate and/or draws high current	Excessive load	Reduce load.
	Low voltage during start	Check for high resistance. Make sure that an adequate cable size is used.
	Defective squirrel cage rotor	Replace with a new rotor.
	Applied voltage too low	Correct power supply.
Wrong rotation direction	Wrong sequence of phases	Reverse connections at motor or at switchboard.
Motor overheats while running	Overload	Reduce load.
	Frame or ventilation openings may be full of dirt and prevent proper ventilation of motor	Open vent holes and check for a continuous stream of air from the motor.
	Motor may have one phase open	Check that all leads and cables are well connected.
	Grounded coil	Motor must be rewound.
	Unbalanced terminal voltage	Check for faulty leads, connections and transformers.
Motor vibrates	Motor misaligned	Realign.
	Weak support	Strengthen base.
	Coupling out of balance	Balance coupling.
	Driven equipment unbalanced	Rebalance driven equipment.
	Defective bearings	Replace bearings.
	Bearings not in line	Repair motor.
	Balancing weights shifted	Rebalance rotor.
	Contradiction between balancing of rotor and coupling (half key – full key)	Rebalance coupling or rotor.
	Poly-phase motor running single phase	Check for open circuit.
	Excessive end play	Adjust bearing or add shim.
Scraping noise	Fan rubbing end shield or fan cover	Correct fan mounting.
	Loose on bedplate	Tighten holding bolts.
Noisy operation	Air gap not uniform	Check and correct end shield fits or bearing fits.
	Rotor unbalance	Rebalance rotor.

TROUBLE	CAUSE	WHAT TO DO
Hot bearings	Bent or sprung shaft	Straighten or replace shaft.
	Excessive belt pull	Decrease belt tension.
	Pulleys too far away from shaft shoulder	Move pulley closer to motor bearing.
	Pulley diameter too small	Use larger pulleys.
	Misalignment	Correct by realigning the drive.
	Insufficient grease	Maintain proper quality and amount of grease in bearing.
	Deterioration of grease or lubricant contaminated	Remove old grease, wash bearings thoroughly in kerosene and replace with new grease.
	Excess lubricant	Reduce quantity of grease: bearing should not be more than half full.
	Overloaded bearing	Check alignment, side and end thrust.
	Broken ball or rough races	Clean housing thoroughly, and then replace bearing.

11. Figures



Key

X-axis: Winding temperature, Celsius Degrees

Y-axis: Insulation Resistance Temperature Coefficient, ktc

1) To correct observed insulation resistance, R_i, to 40 °C multiply it by the temperature coefficient k_{tc}. $R_{i\ 40\ °C} = R_i$ x

Figure 1. Diagram illustrating the insulation resistance dependence from the temperature and how to correct the measured insulation resistance to the temperature of 40 °C.

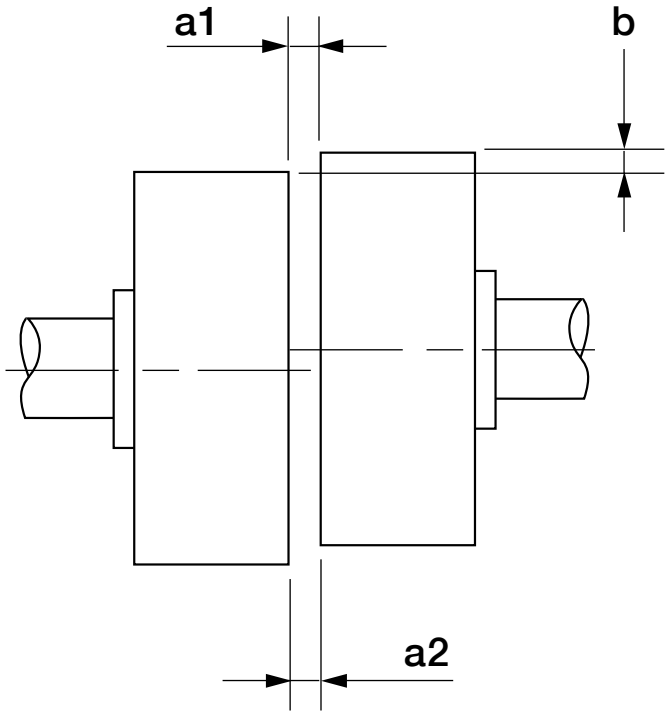


Figure 2. Mounting of half-coupling or pulley

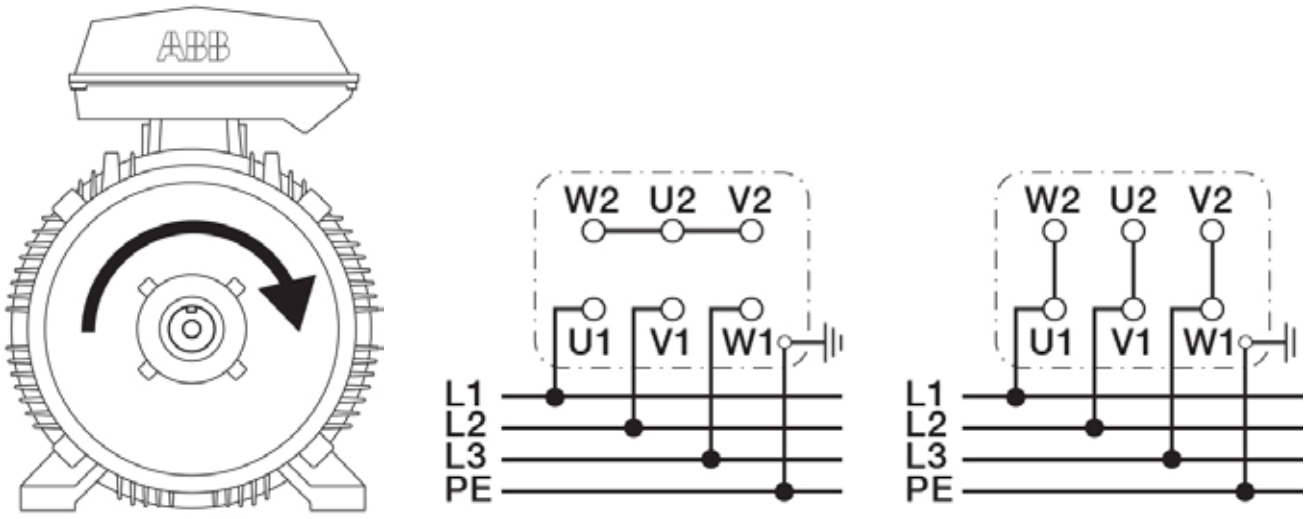
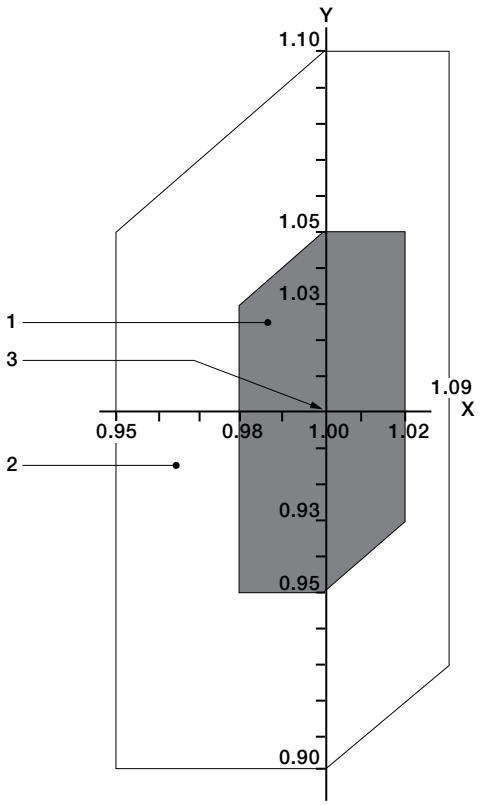


Figure 3. Connection of terminals for main supply



Key	
X axis	frequency p.u.
Y axis	voltage p.u.
1	zone A
2	zone B (outside zone A)
3	rating point

Figure 4. Voltage and frequency deviation in zones A and B

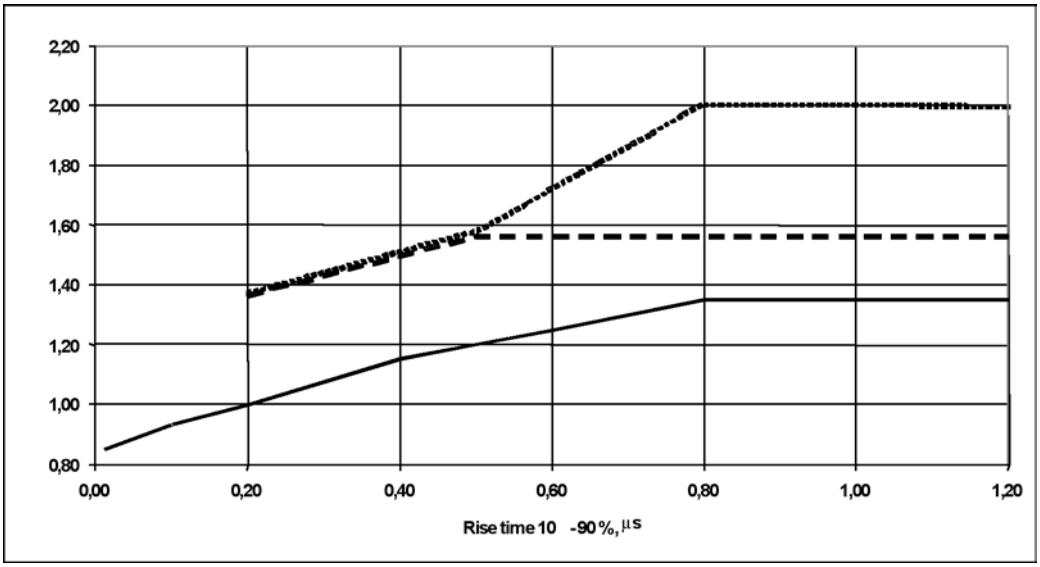
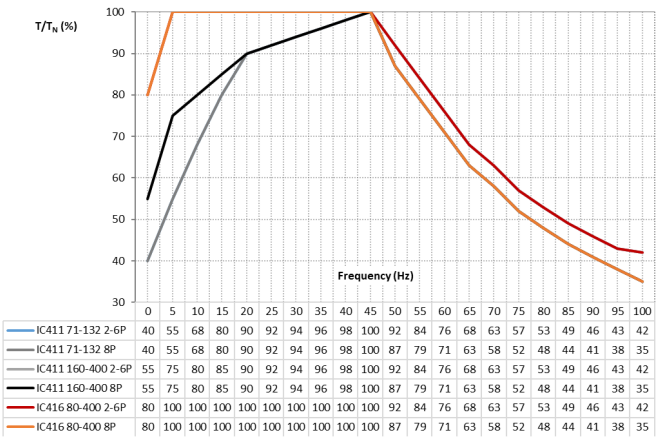


Figure 5. Allowed phase to phase voltage peaks at motor terminals as a function of rise time.

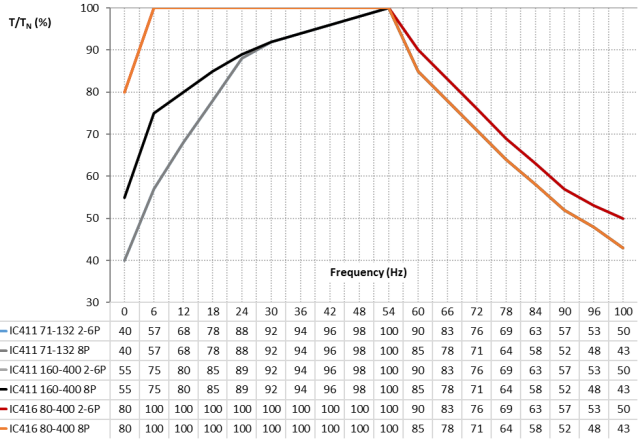
Loadability curves with ACS800/880 converters

Loadability with ABB ACS 800/880 converters, DTC control, Flameproof motors Ex d/Ex db / Ex de/Ex db eb T4, frame size 80 - 400 and Dust ignition protection motors Ex t , frame sizes 71 -400 / 50Hz



	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
IC411 71-132 2-6P	40	55	68	80	90	92	94	96	98	100	92	84	76	68	63	57	53	49	46	43	42
IC411 71-132 8P	40	55	68	80	90	92	94	96	98	100	87	79	71	63	58	52	48	44	41	38	35
IC411 160-400 2-6P	55	75	80	85	90	92	94	96	98	100	92	84	76	68	63	57	53	49	46	43	42
IC411 160-400 8P	55	75	80	85	90	92	94	96	98	100	87	79	71	63	58	52	48	44	41	38	35
IC416 80-400 2-6P	80	100	100	100	100	100	100	100	100	100	92	84	76	68	63	57	53	49	46	43	42
IC416 80-400 8P	80	100	100	100	100	100	100	100	100	100	87	79	71	63	58	52	48	44	41	38	35

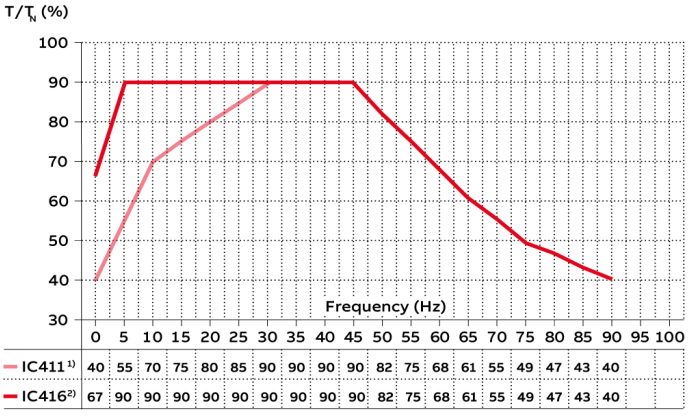
Loadability with ABB ACS 800/880 converters, DTC control, Flameproof motors motors Ex d/Ex db / Ex de/Ex db eb T4, frame size 80 - 400 and Dust ignition protection motors Ex t , frame sizes 71 - 400 / 60Hz



	0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	100
IC411 71-132 2-6P	40	57	68	78	88	92	94	96	98	100	90	83	76	69	63	57	53	50
IC411 71-132 8P	40	57	68	78	88	92	94	96	98	100	85	78	71	64	58	52	48	43
IC411 160-400 2-6P	55	75	80	85	89	92	94	96	98	100	90	83	76	69	63	57	53	50
IC411 160-400 8P	55	75	80	85	89	92	94	96	98	100	85	78	71	64	58	52	48	43
IC416 80-400 2-6P	80	100	100	100	100	100	100	100	100	100	90	83	76	69	63	57	53	50
IC416 80-400 8P	80	100	100	100	100	100	100	100	100	100	85	78	71	64	58	52	48	43

Figure 6. Flameproof motors Ex d/Ex db / Ex de/Ex db eb T4, cast iron dust ignition protection motors Ex t ; nominal frequency of motor 50/60Hz

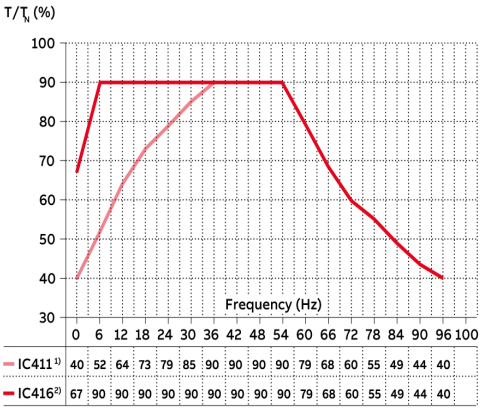
Loadability with ABB ACS 800/880 converters, DTC control, increased safety motors Ex ec/Ex nA T3, frame size 71 - 450 andDust ignition protection motors Ex t /Ex tD , frame sizes 71 - 450 / 50Hz



	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
IC411 [1]	40	55	70	75	80	85	90	90	90	90	82	75	68	61	55	49	47	43	40		
IC416 [2]	67	90	90	90	90	90	90	90	90	90	82	75	68	61	55	49	47	43	40		

[1] Self ventilated, IEC frame size 71 - 450
[2] Separate motor cooling (force ventilated)

Loadability with ABB ACS 800/880 converters, DTC control, increased safety motors Ex ec/Ex nA T3, frame size 71 - 450 andDust ignition protection motors Ex t/Ex tD , frame sizes 71 - 450 / 60Hz

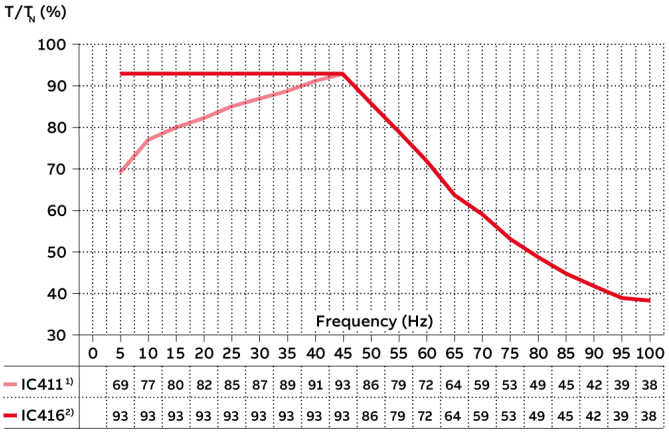


	0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	100
IC411 [1]	40	52	64	73	79	85	90	90	90	90	79	68	60	55	49	44	40	
IC416 [2]	67	90	90	90	90	90	90	90	90	90	79	68	60	55	49	44	40	

[1] Self ventilated, IEC frame size 71 - 450
[2] Separate motor cooling (force ventilated)

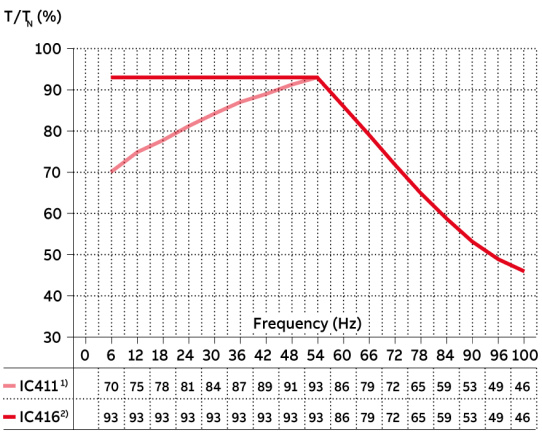
Figure 7. Increased safety motors Ex ec/Ex nA, cast iron and aluminum dust ignition protection motors Ex t/Ex tD ; nominal frequency of motor 50/60 Hz

Loadability with ABB ACS 800/880 converters, DTC control, Flameproof motors Ex d/Ex db / Ex de/Ex db eb T4, frame size 450 andDust ignition protection motors Ex t , frame sizes 450 / 50Hz



1) Self ventilated, IEC frame size 450
2) Separate motor cooling (force ventilated)

Loadability with ABB ACS 800/880 converters, DTC control, Flameproof motors Ex d/Ex db / Ex de/Ex db eb T4, frame size 450 andDust ignition protection motors Ex t , frame sizes 450 / 60Hz

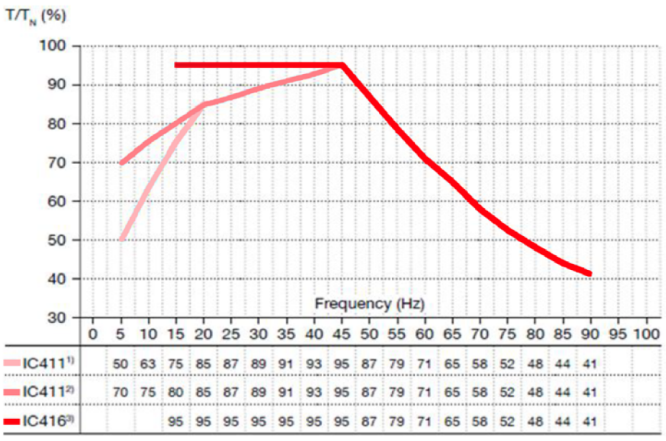


1) Self ventilated, IEC frame size 450
2) Separate motor cooling (force ventilated)

Figure 8. Flameproof motors Ex d/Ex db / Ex de/Ex db eb T4, cast iron dust ignition protection motors Ex t ; nominal frequency of motor 50/60Hz

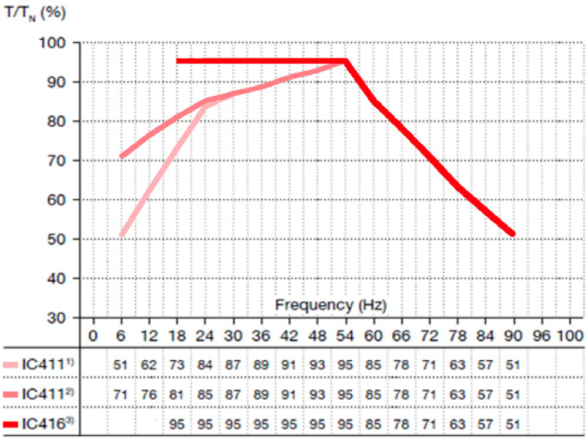
Loadability curves with ACS550/580 converters and other voltage source convereters

Loadability with ABB ACS 550 /580 converters, Flameproof motors Ex d/Ex db / Ex de/Ex db eb T4, frame size80 - 400 and Dust ignition protection motors Ex t ,frame sizes 71 - 400 / 50Hz



[1] Self ventilated, IEC frame size 71 - 132
[2] Self ventilated, IEC frame size 160 - 400
[3] Separate motor cooling (force ventilated)

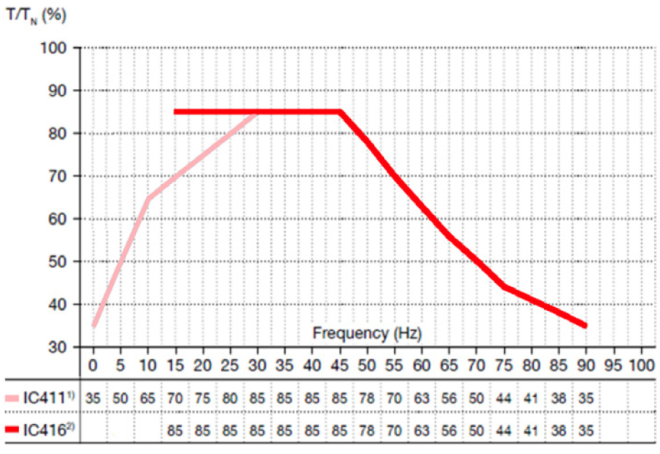
Loadability with ABB ACS 550 /580 converters, Flameproof motors Ex d/Ex db / Ex de/Ex db eb T4, frame size80 - 400 and Dust ignition protection motors Ex t ,frame sizes 71 - 400 / 60Hz



[1] Self ventilated, IEC frame size 71 - 132
[2] Self ventilated, IEC frame size 160 - 400
[3] Separate motor cooling (force ventilated)

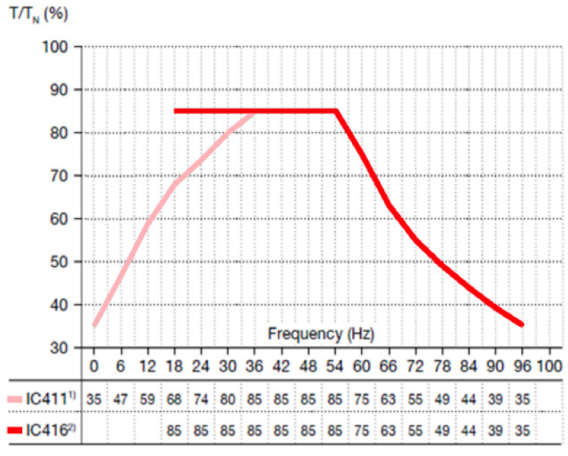
Figure 9. Flameproof motors Ex d/Ex db /Ex de/Ex db eb T4, cast iron dust ignition protection motors Ex t ; nominal frequency of motor 50/60 Hz

Loadability with ABB ACS 550/580 converters, Increased safety motors Ex ec/Ex nA T3, frame size 71 - 450 and Dust ignition protection motors Ex t/Ex tD ,frame sizes 71 - 450 / 50Hz



[1] Self ventilated, IEC frame size 71 - 450
[2] Separate motor cooling (force ventilated)

Loadability with ABB ACS 550/580 converters, Increased safety motors Ex ec/Ex nA T3,frame size 71 - 450 and Dust ignition protection motors Ex t/Ex tD ,frame sizes 71 - 450 / 60Hz



[1] Self ventilated, IEC frame size 71 - 450
[2] Separate motor cooling (force ventilated)

Figure 10. Increased safety motors Ex ec/Ex nA , cast iron dust ignition protection motors Ex t /Ex tD ; nominal frequency of motor 50/60 Hz

Appendix

Information for users, waste treatment facilities and marking

This document is prepared according to EU Directive 2012/19/EU (WEEE) to give end-users the necessary information on how to treat and dispose of EEE (Electrical and Electronic Equipment) waste after it has been removed from service and is to be recycled.

Marking of the products

Products that are marked with the crossed-out wheeled bin symbol as below and/or the symbol is in-cluded in its documentation shall be handled in the following way:

For private households

The crossed–out wheeled bin symbol on the product(s) and / or accompanying documents means that used electrical and electronic equipment (WEEE) should not be mixed with general household waste. For proper treatment, recovery and recycling, please take this product(s) to designated collection points where it will be accepted free of charge.

Alternatively, in some countries, you may be able to return your products to your local retailer upon pur-chase of an equivalent new product.

Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which might otherwise arise from inappropriate waste handling.

Please contact your local authority for further details of your nearest designated collection point.

Depending on your national legislation, incorrect disposal of this waste may incur a penalty in your coun-try.For professional users in the European Union

The crossed –out wheeled bin symbol on the product(s) and / or accompanying documents means that used electrical and electronic equipment (WEEE) should not be mixed with general household waste.

If you wish to dispose of electrical and electronic equipment (EEE), please contact your dealer or sup-plier for further information.

Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling.

For disposal in countries outside the European Union

The crossed–out wheeled bin symbol is only valid in the European Union (EU) and means that used elec-trical and electronic equipment (WEEE) should not be mixed with general household waste.

If you wish to dispose of this product, please contact your local authorities or dealer for the correct method of disposal.

Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling.

EU Declaration of Conformity

The products: 3-phase induction motors for potentially explosive atmospheres as listed in the Annex of this document having correspondent name plate markings covered by those as listed.

The Manufacturer: ABB Shanghai Motors Co., Ltd.
No.88 Tianning Road, Minhang (Economic & Technical Development Zone)
Shanghai 200245 P.R. of China

This declaration of conformity is issued under the sole responsibility of the manufacturer.

The motors of the declaration referred to the Annex are in conformity with the relevant Union harmonisation legislation:

Directive 2014/34/EU

The following harmonised standards are applied in relation to which conformity is declared:
EN IEC 60079-0:2018, EN 60079-1:2014, EN 60079-31:2014 , relevant parts of the EN 60034 –series of standards.

Directive 2009/125/EC

The motors that are marked as IE2, IE3 or IE4 are in conformity with the requirements set in the Commission Regulation (EU) 2019/1781 and the amending Regulation (EU) 2021/341 from 1st of July 2021 and onwards. Standards EN 60034-2-1:2014 and EN 60034-30-1 are applied in relation to which conformity is declared.

Directive 2011/65/EU

Motors are in conformity with the Directive 2011/65/EU and the amending Annex II to this Directive of the Delegated Directive (EU) 2015/863 of the European Parliament and of the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment. Technical documentation based on EN IEC 63000:2018.

Notes:

Motors shall be installed and maintained according to the relevant standards and instructions of ABB Shanghai Motors Co., Ltd. When installed in converter supplied applications, additional requirements must be respected regarding the motor as well as the installation as described in the appropriate dedicated addendum.

The conformity of the incorporation into a finished machine according to the Directive 2006/42/EC shall be established by the commissioning party when a motor is fitted to the machinery.

According to the Regulation (EU) 2019/1781 motors placed on the market before 1 July 2029 as substitutes for identical motors integrated in products placed on the market before 1 July 2021 for motors referred to in Annex I.1 (a), and specifically marketed as such are exempt from the efficiency requirements.

Notified Body (ExNB): CNEX-Global B.V.(2614), Utrechtseweg 310-B42, 6812 AR Arnhem, The Netherlands

Signed for and on behalf of: ABB Shanghai Motors Co., Ltd.
Place and date of issue: Shanghai, China, 2021-03-31

Signed by

Name: Robert Chin
Title: Global R&D Manager

Signed by

Name: Hui Luo
Title: China Local Division Manager

Annex:

Group & category, temperature class, type of protection, equipment protection level (EPL)	Motor type, IEC frame sizes	Certificate number
Flameproof enclosure "db" II 2 G Ex db IIB / IIC T4 Gb **Dust ignition protection by enclosure "tb"** II 2 D Ex tb IIIB / IIIC T130℃ Db	M3JP 80-132	CNEX 21 ATEX 0002 X
	M3JP 160-355	CNEX 18 ATEX 0032 X

3GZC500930-77 C

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