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1) MOTORS

- Squirrel-cage motors
- Double winding for two speed motor
- Synchronous speed : 3000 / 500 rpm for 50 hertz
- Synchronous speed : 3600 / 600 rpm for 60 hertz
- Power range from 1.9 to 15 kW for 50 hertz
- Power range from 2.2 to 18 kW (2.9 to 24 HP) for 60 hertz
- IP55 protection
- Insulation Class F
- Tropicalized as an option
- Thermistors for over-temperature protection
- Aluminum frame
- N1….N4 are standard two speed hoisting motors.
- F2….F4 are standard inverter hoisting motors.

1.1.1 Ambient temperature

The design of the motors is based on a maximum ambient temperature of 40º C (104º F).
If ambient temperature exceeds 40º C (104º F), a motor from a higher classification must be selected:

For ambient temperatures in the range 40º C -55º C (104º F -131º F), the motor must be selected from one step higher in the Motor Group classification.

For ambient temperatures in the range 55º C-65º C (131º F -149º F), the motor must be selected from two step higher in the Motor Group classification.

Environmental Factors
The standard SM2000 Hoist Motor is designed for operation at a maximum ambient temperature of 40 ºC (104 ºF) at a maximum altitude of 1000 m (3280 ft.). If these environmental conditions are exceeded, make sure that the motor has been specified for this special application.
The hoist must be installed in such a position that the cooling air can circulate freely over the motor.
The heated air must not recirculate back immediately to the cooling fan inlet.

1.1.2 N -motors

These motors (N1, N2, N3, and N4) are standard 2-speed hoist motors.

1.1.3 F -motors

These motors (F2, F3, and F4) are specially designed for use with a variable frequency drive and all of these motors only have a single winding.
The variable frequency drive utilizes a general-purpose inverter that can modify both the frequency and the voltage of the supply waveform to the motor. The speed of the motor can be then be controlled over its full range in a stepless manner.
These motors are equipped with a pulse sensor for speed feedback to the variable frequency drive. The electric brake is also controlled by the variable frequency drive.

1.2 Motor winding temperature protection

As standard, on all SM2000 hoist motors, thermistors (electrothermal sensors) for over-temperature protection are embedded in the stator windings. The sensors have a low resistance until their temperature rises to a set point, whereupon resistance increases several orders of magnitude for a relatively small change in temperature. This sharp increase in resistance causes a thermal relay to de-energize a pilot circuit. Each phase winding has its own thermistor so that there are three thermistors in a single speed motor and six thermistors in a 2-speed motor. The thermistors are connected in series within the motor.

1.3 Motor cooling

All motors have a ribbed outer casing to maximize convection cooling.

1.3.1 Hoist motor sizes MF09 - MF13

SM2000 hoist motors in the size range MF09 - MF13 are normally fitted with an integral cooling fan that is directly driven by the motor shaft.
Because the shaft driven fan is only effective while the hoist motor is rotating, this cooling may not be sufficient for certain applications, especially where the ambient temperature is high. In these cases, a blower fan replaces the shaft driven fan.

1.4 Mechanical brake

SM2000 hoist motor is fitted with a disc brake to hold the shaft stationary when the motor is not energized. This electric brake is integrated into the design of the motor and is located between the motor casing and the cooling fan. A single disc is used, with friction linings on both sides.
The hub of the disc is engaged onto a toothed spline on the motor shaft so that it always rotates with the motor. The disc can move axially along the shaft to accommodate any wear in the friction linings. The brake is engaged by a number of coil springs that force a stationary pressure plate against the disc. There is also a fixed backing plate between the other side of the disc and the motor casing. To release the brake, the solenoid coil is energized. The attraction force from the solenoid is greater than the force of the springs and so the brake is released.
Because the brake always engages when the solenoid is not energized, the system is fail-safe.

1.4.1 Characteristics of the brake

The brake type depends on the motor type and on the nominal voltage of the motor.

Motor code	Brake type	Braking torque
N1	NM304NR_*	10.8 Nm
N2	NM305NR_*	21.6 Nm
N3,F3	NM306NR_*	44 Nm
N4,F4	NM307NR_*	87 Nm

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*Depending on the nominal voltage of the motor, the voltage code of the brake is as follows:

Nominal voltage of the motor	Voltage code of the brake	Nominal voltage of brake
346V - 480V	NR1	190 V
500V - 600V	NR2	220 V
660V - 690V	NR3	290 V
200V - 240V	NR4	100 V

Brake adjustment

The electric brake is released by a solenoid that overcomes the forces of the brake engagement springs. For this solenoid to operate correctly, the air gap between the coil body and the armature plate must be within certain limits. If the air gap is too small, the brake will not release completely. If the air gap is too large, the solenoid force will not be strong enough to attract the armature and the brake will remain fully engaged.
As the friction linings on the brake disc wear, the air gap increases. To compensate for this effect, the air gap must be adjusted.

1.4.2 Automatic brake adjustment (MF09 - MF13 Standard)

For the brakes fitted to the motors in this size range, the solenoid coil is directly attached to the brake pressure plate. The armature ring is at the outer end of the brake assembly and this ring does not move when the solenoid is energized.
This armature ring with a threaded outer circumference engages matching thread in the brake body. By turning the armature ring, the air gap is set.
As standard, the brakes for the motors in this size range are fitted with an automatic adjustment mechanism. This consists of a multi-turn spring between the armature ring and the brake body. This spring acts to turn the armature ring in the direction that reduces the air gap.
The air gap is prevented from reducing to zero by a neoprene O-ring. The solenoid force can compress O-ring, but it can not be compress by the automatic adjustment mechanism.

1.4.3 Manual brake adjustment (MF09 - MF13 Special)

In certain operating environments, especially where there is a large amount of airborne dust or smoke particles, the automatic adjustment mechanism can become clogged by the dirt and can stop functioning.
If no remedial action is taken, the solenoid will eventually stop releasing correctly, leaving the brake partially engaged. As a result of partial engagement, the wear rate of brake will increase significantly. Ultimately, the brake can fail if the friction linings are worn away completely.
To avoid this potentially dangerous situation, the automatic adjustment mechanism is not fitted to hoist motors that will be used in such hostile environments. Instead, the solenoid ring is prevented from rotating inside the brake body by an adjustable bracket.
The brake must be inspected and adjusted manually as part of a routine maintenance procedure.

1.5 "Lining Worn" sensing (MF09 - MF13)

A "Lining Worn" sensing circuit is fitted to all of the brake sizes that can have the automatic adjustment mechanism. This sensing circuit consists of a loop of insulated wire that is embedded within the friction lining of the brake. When the lining is worn, the brake disc open the sensing loop. This sensing circuit is wired into the motor control logic to ensure that the hoist cannot be operated in an unsafe condition.

For the smaller motor sizes (MF09, MF10, MF11), the wear-sensing loop is only in one friction lining. For other MF13 motors, the sensing loop is in both friction linings (wired in series).

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2) Main characteristics

Two-speed Hoist Motor at 50 Hertz

MOTOR CODE		N1	N2	N3	N4
Motor type		MF09ZA106	MF10Z-106	MF11Z-106	MF13ZA106
synchronous speed	rpm	3000/500	3000/500	3000/500	3000/500
Braking torque	Nm	10.8	21.6	44	87
Power fact. start		0.89/0.80	0.82/0.79	0.75/0.68	0.65/0.61
Starting torque	Nm	12/10.7	26/22	48/42	105/86
Weight	Kg	23	30	50	87
Load	tm/min	8	20	40	80
Nominal power *	**kW**	**1.5/0.25**	**3.5/0.5**	**7.5/1.2**	**15/2.5**
Nominal torque	Nm	4.7	12.7	24.7	48
Nominal speed	r/min	2750/400	2780/400	2750/360	2810/430
Short time duty	min	15/15	15/11	15/10	15/10
Power factor		0.83/0.63	0.87/0.63	0.85/0.55	0.86/0.49
Efficiency		0.67/0.25	0.71/0.28	0.74/0.30	0.78/0.44

*) Power are given with nominal load

Two-speed Hoist Motor at 60 Hertz

Motor code		N1	N2	N3	N4
Motor type		MF09ZA106	MF10Z-106	MF11Z-106	MF13ZA106
Synchronized speed	RPM	3600/600	3600/600	3600/600	3600/600
Braking torque	Nm	10.8	21.6	44	87
Power fact. start		0.88/0.78	0.80/0.77	0.73/0.67	0.64/0.56
Starting torque	Nm	11.6/10.3	26/22	48/42	102/82
Weight	kg	23	30	50	87
Inertia	kgm^2	0.0041	0.0047	0.0090	0.0393
Load	tm/min	12/2.0	23/3.0	49/8.0	95/16
Nominal power*	**HP**	**3/0.5**	**5.6/0.83**	**12/2**	**24/4**
Nominal power*	**kW**	**2.2/0.37**	**4.2/0.6**	**9/1.5**	**18/3**
Nominal torque	Nm	6.3	12.7	24.7	48
Nominal speed	RPM	3260/475	3380/500	3350/450	3400/520
Short time duty	min	15/15	15/11	15/10	15/10
Power factor		0.91/0.61	0.87/0.61	0.87/0.55	0.90/0.48
Efficiency		0.67/0.31	0.75/0.31	0.73/0.33	0.79/0.48

*) Powers are given with nominal load.

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2) Main characteristics

Inverter Hoist Motor at 50 Hertz

MOTOR CODE	F3	F4
Motor type	MF11L-100	MF13L-100
Synchronous speed rpm	3000	3000
Braking torque Nm	44	87
Power factor - start	1.0/1.0	1.0/1.0
Starting torque Nm	78	120
Weight Kg	46	78
Load tm/min	40	80
Nominal power * kW	**7.5**	**15**
Nominal torque Nm	24.7	48
Nominal speed r/min	2860	2860
Power factor	0.90	0.93
Efficiency	0.83	0.84

*) Power with nominal load

Inverter Hoist Motor at 60 Hertz

MOTOR CODE	F3	F4
Motor type	MF11L-100	MF13L-100
Synchronous speed rpm	3600	3600
Braking torque Nm	44	87
Power factor - start	1.0/1.0	1.0/1.0
Starting torque Nm	78	120
Weight Kg	46	78
Load tm/min	48	96
Nominal power HP	**12**	**24**
Nominal power * kW	**9**	**18**
Nominal torque Nm	24.7	48
Nominal speed r/min	3460	3460
Power factor	0.90	0.93
Efficiency	0.85	0.86

*) Powers are given with nominal load.

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3) Currents (Motors 50 Hz)

Motor type	Currents * (fast/slow speed)	Duty Group	Voltage 220 V	380 V	400 V	415 V	500 V	660 V
N1	Starting current (A)		29/5.5	17/3.2	16/3.0	15/2.9	13/2.4	9.7/1.8
MF09ZA106	Nominal current (A)	1Am	6.4/4.0	3.7/2.3	3.5/2.2	3.4/2.2	2.8/1.8	2.1/1.3
		2m	5.8/4.0	3.4/2.3	3.2/2.2	3.1/2.2	2.6/1.8	1.9/1.3
		3m	5.3/4.0	3.1/2.3	2.9/2.2	2.8/2.2	2.3/1.8	1.8/1.3
N2	Starting current (A)		70/12	41/6.8	39/6.5	38/6.3	31/5.2	24/3.9
MF10Z-106	Nominal current (A)	1Am	15.0/7.8	8.5/4.5	8.1/4.3	7.8/4.1	6.5/3.4	4.9/2.6
		2m	13.0/7.8	7.6/4.5	7.2/4.3	6.9/4.1	5.8/3.4	4.4/2.6
		3m	11.0/7.8	6.4/4.5	6.1/4.3	5.9/4.1	4.9/3.4	3.7/2.6
N3	Starting current (A)		133/22	77/13	73/12	70/12	58/9.6	44/7.3
MF11Z-106	Nominal current (A)	1Am	30.0/14.0	17.0/8.2	16.5/7.8	16.0/7.5	13.0/6.2	10.0/4.7
		2m	26.0/14.0	15.0/8.2	14.0/7.8	14.0/7.5	11.0/6.2	8.5/4.7
		3m	22.0/14.0	13.0/8.2	12.0/7.8	12.0/7.5	9.6/6.2	7.3/4.7
N4	Starting current (A)		291/51	168/29	160/28	154/27	128/22	97/17
MF13ZA106	Nominal current (A)	1Am	56.0/27.0	33.0/16.0	31.0/15/0	30.0/15.0	25.0/12.0	19.0/9.1
		2m	47.0/27.0	27.0/16.0	26.0/15.0	25.0/15.0	21.0/12.0	16.0/9.1
		3m	40.0/27.0	23.0/16.0	22.0/15.0	21.0/15.0	18.0/12.0	13.0/9.1

3) Currents (Motors 60 Hz)

Motor type	Currents (fast/slow speed)	Duty Group	Voltage 220 V	380 V	440 V	460 V	480 V	600 V
N1	Starting current (A)		33/6.3	19/3.6	17/3.1	16/3	15/2.9	13/2.4
MF09ZA106	Nominal current (A)	1Am	7.3/4.6	4.2/2.7	3.7/2.3	3.5/2.2	3.4/2.1	2.8/1.8
		2m	6.7/4.6	3.9/2.7	3.3/2.3	3.2/2.2	3.1/2.1	2.6/1.8
		3m	5.0/4.6	2.9/2.7	2.5/2.3	2.4/2.2	2.3/2.1	2.3/1.8
N2	Starting current (A)		82/14	47/7.9	41/6.8	39/6.5	37/6.2	31/5.2
MF10Z-106	Nominal current (A)	1Am	17/9.0	10/5.2	8.6/4.5	8.2/4.3	7.9/4.1	6.6/3.4
		2m	15/9.0	8.7/5.2	7.5/4.5	7.2/4.3	6.9/4.1	5.8/3.4
		3m	13/9.0	7.4/5.2	6.4/4.5	6.1/4.3	5.8/4.1	4.9/3.4
N3	Starting current (A)		138/25	80/15	69/13	66/12	63/12	58/9.6
MF11Z-106	Nominal current (A)	1Am	36/16	21/9.4	18/8.2	17/7.8	16/7.5	13/6.2
		2m	29/16	17/9.4	15/8.2	14/7.8	13/7.5	11/6.2
		3m	25/16	15/9.4	13/8.2	12/7.8	12/7.5	9.6/6.2
N4	Starting current (A)		335/59	194/34	167/29	160/28	153/27	128/22
MF13ZA106	Nominal current (A)	1Am	65.0/31.0	38.0/18.0	32.0/16.0	31.0/15.0	30/14	25/12
		2m	54.0/31.0	31.0/18.0	27.0/16.0	26.0/15.0	25/14	21/12
		3m	46.0/31.0	27.0/18.0	23.0/16.0	22.0/15.0	21/14	18/12

*) Current with nominal load

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4) Hoisting motor description