Three-phase asynchronous motors with slip-ring rotor for continuous and intermittent duty

Product specification

Series SPER, S11R, SPEH, S11H

Introduction

Electrical drives in their many variations are now in use in every branch of industry. In most processes, they determine by virtue of their characteristics the economy of production. The three-phase asynchronous motors for low voltage from VEM motors GmbH meet the needs of operators with regard to all-round versatility, superior performance parameters, environmental compatibility and high standard of reliability. VEM motors are designed for the whole of European market and offer

- Economical performance, due to high motor efficiencies
- Versatility and reduction of stock due to series version in IP 55 degree of protection (higher degree of protection on request)
- Increased lifetime, reliability and thermal overload capacity by series version insulation class F with thermal reserve (special version insulation class H on request)
- Environmental acceptability due to use of a low-noise bi-directional ventilation system
- Supply option complying with Eastern European standards
- Performance option of a classic IEC/DIN series and a progressive one based on the IEC 72 for attachment dimensions and frame sizes
- Attachment options for components as impulse sensors, tacho-generators, brakes, speed sensors and forced-ventilation units for accomplishment with recent control methods

Standards and regulations

The motors comply with the relevant standards and regulations and specifically with the following:

Title	DIN EN / DIN VDE	IEC
Rotating electrical machines, rating and performance	DIN EN 60034-1/11.95	IEC 34-1 IEC 85
Totally enclosed three-phase induction motors with slip-ring rotor, type IM B3	DIN 42679	(IEC 72)
Totally enclosed three-phase induction motors with slip-ring rotor, intermittent duty	DIN 42681	(IEC 72)
Rotating electrical machines, terminal markings and direction of rotation	DIN VDE 0530 p. 8	IEC 34-8
Rotating electrical machines, symbols for types of construction and mounting arrangements	DIN EN 60034-7	IEC 34-7
Rotating electrical machines, built-in thermal protection	-	IEC 34-11
Rotating electrical machines, methods of cooling	DIN EN 60034-6	IEC 34-6
Rotating electrical machines, classification of degrees of protection provided by enclosures	DIN VDE 0530 p. 5	IEC 34-5
Rotating electrical machines, mechanical vibrations of certain machines	DIN EN 60034-14	IEC 34-14
Cylindrical shaft ends for rotating electrical machines	DIN 748 p. 3	IEC 72
Conical shaft ends for electrical machines	DIN 1448	
Conical shaft ends with inner thread	DIN 1449	
IEC standard voltages	DIN IEC 38	IEC 38

Furthermore, VEM motors comply with various foreign regulations which have been adapted to IEC 34-1

NF C 51	France	NBNC 51-101	Belgium
ÖVE M10	Austria	CEI 2-3, V1	Italy
SS 426 0101	Sweden	NEK-IEC 34-1	Norway
SEV 3009	Switzerland	BS 5000 BS 4999	United Kingdom of Great Britain

Progressive correspondence between output and size

VEM three-phase motors with slip-ring rotor are available in two type series, both based on IEC 72 as regards dimensions and frame sizes (type co-ordination see tables of Motor selection data). The **SPER / S11R / SPEH / S11H** series is designed as a classic IEC/DIN series, i.e. fixing dimension and correspondence of output as specified in DIN 42673 / DIN 42677. The **SPR / SPH** series is based on a progressive output correspondence in comparison to these DIN standard. With the same frame size, it offers an output up to two stages higher.

Types of construction and mounting arrangement

The IEC 34-7 specifies two different designations for the motor types of construction .
Code I (e.g. IM B3)
Historically established designation type which does not cover all possible types of construction and does not include the shaft version.
Code II (e.g. IM 1001)
Permits an comprehensive classification.
In accordance with the usual systems in Germany, VEM motors are marked according to Code I on the rating plate. Only version not covered by Code I are marked according to Code II.

Degrees of protection

Degrees of protection for electrical machines are indicated according to DIN IEC p. 5 / VDE 0530 p. 5, through the identification marking ”IP” and two characteristic numerals for the degree of protection. The first characteristic numeral specifies the protection given by the housing against:

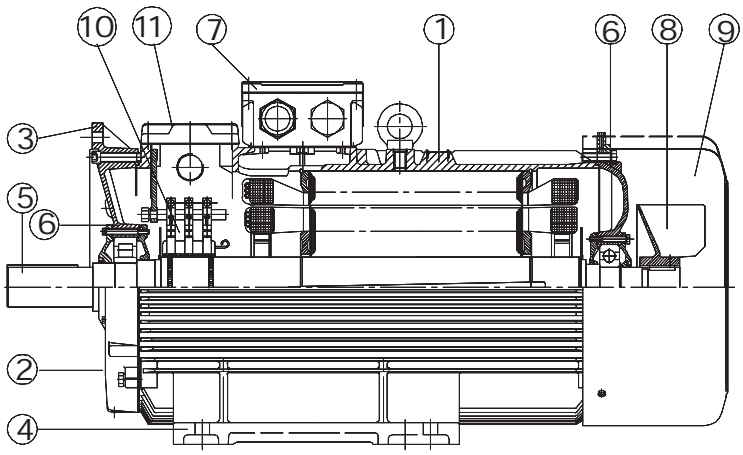
- damaging ingress of dust and foreign particles
- contact with inner moving or living parts

The second characteristic numeral specifies the protection given by the housing against the harmful ingress of water.
In the basic design, VEM slip-ring motors are designed in the degree of protection IP 54. From the size 315 MX, the basic design corresponds to the degree of protection IP 55. Design in higher degrees of protection is possible on request.

Condensed water drain hole

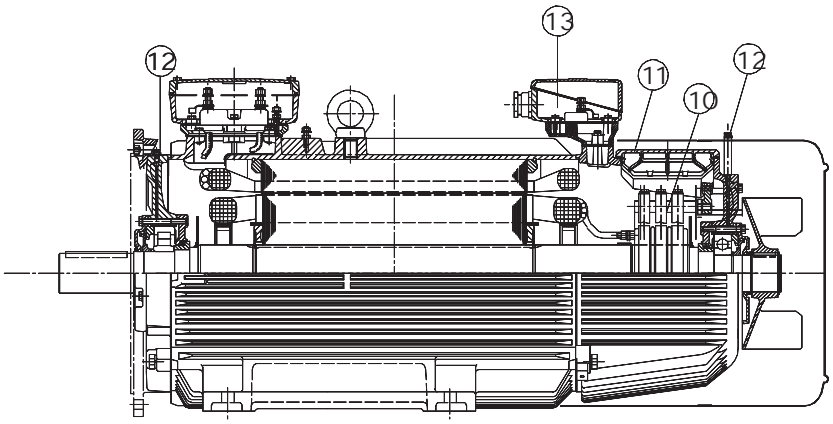
Motors in the degree of protection IP54 are always designed with condensed water drain holes for preventing water accumulations in the interior of the motor. For the purpose of transport and intermediate storage, the holes are provided with plastic seals or, as an option, with condensed water discharging bolts. These seals are to be removed when mounting the motor.
When being designed in the degree of protection IP55, the holes must stay closed. In this case, they are to be opened in regular maintenance intervals so that the possibly accumulated condensed water can drain off.

Design versions



Design version of slip-ring motors S..R/S..H 132 up to 315M

1 housing
2 end-shield
3 flange end-shield
4 foot
5 rotor
6 bearings
7 terminal box
8 fan
9 fan cover
10 sliding-contact system
11 servicing cover



Design version of slip-ring motors S11R/S11H 315 MX - LY

10 sliding-contact system
11 servicing cover
12 relubrication device
13 terminal box for sliding-contact system

Materials for housings, end shields and feets, foot mounting

Shaft height	Series	Material of			Foot mounting
		Housing	End-shields	Feet	
132 – 250M, MX4	SPER/SPEH	Grey cast iron			Bolt-on
250MX6, 8	S11R/S11H				Cast-on
280, 315	S11R/S11H				Cast-on
132 - 225	SPR/SPH				Bolt-on
250, 280	SPR/SPH				Cast-on

Cooling and ventilation

Motors are equipped with radial plastic, sheet steel or aluminium alloy fans which cool the motor, whatever is the direction of rotation (IC 411 according to DIN EN 60034-6).

When installing the motors, care must be taken that a minimum distance from the fan cover to the wall (dimension BI) is maintained.

Vibration behaviour

The permissible vibration intensities of electric motors are specified in DIN EN 60034-14.
The vibration intensity stage N (normal) is achieved or bettered by VEM motors in the basic version. The vibration intensity stages R (reduced) and S (special) are available at extra charge and depending on the type. Please consult the manufacturer.

According to DIN EN 60034-14 the following intensities are recommended:

Vibration intensity stage	Speed range rpm	Limits of vibration velocity (mm/s) in frequency range 10 up to 1000 Hz sizes	
		132 - 200	225 - 400
N (normal)	600-3600	2,8	3,5

All rotors are dynamically balanced with the half key inserted. This balancing is documented on the rating plate with the letter H after motor No., balancing with full key inserted on request, designation in then F after motor No.

Bearings / bearing lubrication

VEM motors are equipped with bearings from excellent manufacturers. The bearings have a nominal service life of at least 20.000 h for maximum permissible load conditions. Without additional axial loading, for coupling service the nominal bearing service life is 40.000 h.

The versions
- fixed bearing N-end
- without fixed bearing
- life lubrication
- relubrication device
- heavy bearing arrangement D-end (for increased lateral forces)
- easy bearing arrangement

and the
- bearing schedule
- disc spring and wave washer schedule
- V-Ring schedule
- figures of bearing arrangements
- flat grease nipples

are shown in the bearing arrangement tables. Fixed bearing D-end is possible on request. Any grooved ball bearings have disc springs and wave washers, respectively, thus they are pre-loaded. This is not true for versions with cylindrical roller bearings.
Motors with life lubrication are also available with a degree of protection IP 56.

Motor sizes 132 – 160 are fitted with life-lubricated bearings. For motors from size 180, depending on the useful life of grease, bearings must be regreased in good time so that the scheduled bearing service life is reached. Under normal operating conditions, the grease packing will last for 20.000 hours of operation with versions from 4-pole upwards without being renewed. For motors fitted with relubrication device and working under normal operating conditions, the grease will last for operation with 4.000 hours of operation with 4- and more-pole version. The standard grease is a KE2N-40 type according to DIN 51825.

Use of cylindrical roller bearings

Using cylindrical roller bearings (heavy bearing arrangement), relatively high radial forces or masses can be accepted at the motor shaft end, e.g. belt drives, pinions or heavy couplings.
The minimum radial force at the shaft end must be at least a quarter of the permissible one. Account must be taken of permissible shaft end loading. Both these values are found in the diagrams.

Important to note:
Radial forces below the minimum value can lead to bearing damage within a few hours. Test runs in no-load state are only permissible for a short period.

If the specified minimum radial forces cannot be met, we recommend the use of grooved ball bearings (easy bearing arrangement). Bearing change on request.

Paint finish

Normal finish
- Adapted for climate group ”moderate” according to IEC 721-2-1
  - Weather-protected and non-weather-protected locations, open-air conditions, short-time up to 100 % relative humidity at temperatures up to + 30 °C, continuously up to 85 % relative humidity at temperatures up to + 25 °C

Finish system
- prime coat plastic resin / zinc phosphate, layer thickness ≥ 30 µm
- finish coat 2K-(separate-application) polyurethane varnish, layer thickness ≥ 30 µm

Special finish

- Adapted for group of climates ”world wide” according to IEC 721-2-1
  Non-weather-protected locations, open-air conditions, in aggressive atmospheres (chemical industries, sea environments), short-time up to 100 % relative humidity at temperatures up to +35 °C, continuously up to 98 % relative humidity at temperatures up to +30 °C.

Finish system
- prime coat plastic resin / zinc phosphate, layer thickness ≥ 30 µm
- second coat on separate-application base, layer thickness 30 ≥ µm
- finish coat 2K (separate-application) polyurethane varnish, layer thickness ≥ 30 µm

Standard colour:
RAL 7031 blue grey

Further special coating systems
- version for excessive thermal stresses
- version for excessive chemical and radiation stresses
- systems on customer’s request

Shaft ends

According to IEC 34-7, the definition of the motor ends is as follows:

D-end (DS):
Drive end of the motor

N-Seite (NS):
Non-driving end (opposite to the drive end)

Centre holes according to DIN 332, sheet 1 and 2, Form DS.

For sizes 56 – 112, keys and key-ways are according to DIN 6885 sheet 1, Form B, and for the sizes 132 - 355 according to DIN 6885 sheet 1, Form A. Key length for sizes 132 – 355 are according to DIN 748 p. 3 Draft. Dec. 91.

Thread for press-on and dismantling devices:

Shaft end diameter	thread
for 9 mm	M3
for 11 mm	M4
for 14 mm	M5
for 19 mm	M6
for 22 mm	M8
for 24 mm	M8
for 28 mm	M10
> 28 up to 38 mm	M12
> 38 up to 50 mm	M16
> 50 up to 85 mm	M20
> 85 up to 130 mm	M24

The motors are always supplied with the key fitted.

The second shaft end can transmit the full power rating with coupling output. The power transmission capability by belt, chain or pinion drive for the second shaft end is available on request. The drive elements used, such as pulleys or couplings, are to be balanced with a balance grade of at least G 6.3 according to DIN ISO 1940, p. 1, with half key inserted.

Design voltage and frequency

In the basic version, motors are supplied for the following design parameters:

230/400 V Δ/Y	50 Hz
400/690 V Δ/Y	50 Hz
690 V Δ	50 Hz
460 V Δ	60 Hz

The motor can run without changing the design output on mains in which the voltage at the design frequency diverges by ± 5 % from the nominal value (design voltage range A), in these mains the frequency can diverge by ± 2 % from the nominal value.

The above standard voltages according to DIN IEC 38 are taken as the design point.
Special voltages and frequencies on request.

Design output

The design output applies for continuous operation as specified in DIN EN 60034-1/11.95, at a coolant temperature of
40 °C and an altitude above sea level of ≤ 1000 m, design frequency 50 Hz and design voltage. The series K11R/K21R and K10R / K20R have thermal reserves which permit, depending on types, the following overloads in continuous operation:
- up to 10 % above the rated output at 40 °C coolant temperature or
- rated output up to 50 °C coolant temperature
- rated output at an installation altitude of up to 2.500 m above sea level

These conditions apply only alternatively, when both apply, the output must be reduced. With motors in the marine version, the output is reduced by 5 % for each 5 °C by which the specified coolant temperature is exceeded, as specified in classifications rules; higher outputs on request.

Motor torque

The design torque in Nm given at the motor shaft is calculated by

$$M = 9550 \cdot \frac{P}{n}$$

with P = design output in kW
n = speed in rpm

In the Motor selection data tables, starting torque, pull-up torque and pull-out torque are given as multiples of design torque.
If the voltage deviates from its design point, the torques change about quadratically.

Ambient temperature

All VEM motors in the basic version can be used at ambient temperatures from -35 °C up to +40 °C.

Overload capacity

In compliance with DIN EN 60034-1, all motors can be exposed to the following overload conditions:
- 1,5 times the rated current for 2 min,
- 1,6 times the rated torque for 15 s (1,5 times for $I_A / I_N > 4,5$)

Both conditions apply to design voltage and design frequency.

Maximum speed

The maximum admissible operation speed is specified in the Motor selection data for hoisting-gear motors. In compliance with DIN EN 60034-1/11.95, the motors are subject to an over-speed with 1,2 times the maximum speed for 2 min. In special design, the motors can also be supplied for higher maximum speeds.

Design efficiency and design power factor

Efficiency η and power factor $\cos \varphi$ are stated in the Motor selection data lists .

Restarting with residual field and phase opposition

Restarting after mains failure against a 100 % residual field is possible for all motors.

Radio interference suppression

VEM slip-ring motors correspond in general to the radio interference degree N according to DIN VDE 0875/EN 55014.

Motor protection

The following motor protection versions are available as an option:
- motor protection with PTC thermistor sensors in the stator winding
- bimetallic temperature sensor as NC contact or NO contact in the stator winding
- resistance thermometer for monitoring the winding or bearing temperature on request

Anti-condensation heating

As an option, the motors can be equipped with anti-condensation heating. So will be prevented a condensation of water in the inside of the motor.

Special duties

Special duty types, as intermittent, short-time duty or electrical braking procedures are possible on request

Tolerances of ratings

According to DIN EN 60034-1/11.95 the following tolerances are permissible:

Efficiency (indirect calculation)	-0,15 (1-η) for $P_N \leq 50$ kW -0,1 (1-η) for $P_N > 50$ kW
Power factor	$\frac{1-\cos\varphi}{6}$ at least 0,02 maximum 0,07
Slip (at rated load and operating temperature)	± 20 % for $P_N \geq 1$kW
Starting current (in the planned starting connection)	+ 20 % without restrictions downwards
Starting torque	- 15 % and + 25 %
Pull-up torque	- 15 %
Pull-out torque	- 10 % (after the application of this tolerance M_K/M at least 1,6)
Moment of inertia	± 10 %
Noise level (sound pressure level)	+ 3 dB (A)

These tolerances are permissible for the values assured for three-phase asynchronous motors, taking the necessary manufacturing tolerances and material variations of the raw material into account.

The standard contains the following notes on this:

1. A guarantee for all or any of the values shown in the table is not mandatory. In tender, the guaranteed value for which permissible deviations should apply must be expressly specified. The permissible variations must correspond to those stated in the table.
2. ”Guarantee”: In some countries, a distinction is drawn between guaranteed values and typical or declared values.
3. If a permissible deviation applies only in one direction then the value in other direction is not limited.

Tolerances mechanical dimensions

lfd. Nr.	Maßkurz-zeichen nach DIN 42939	Bedeutung des Maßes	Passung oder Toleranz
1	a	Abstand der Befestigungslöcher des Gehäusefußes in Achsrichtung	± 1 mm
2	b	Abstand der Befestigungslöcher des Gehäusefußes quer zur Achsrichtung	± 1 mm
3	e_1	Lochkreisdurchmesser des Befestigungsflansches	± 0,8 mm
4	a_1	Durchmesser bzw. Eckmaß des Flansches	+ 1 %
5	g h	Größte Breite des Motors (ohne Klemmenkasten)	+ 2 %
6	k k_1	Gesamtlänge des Motors	+ 1 %
7	p	Gesamthöhe (Unterkane Fuß, Gehäuse oder Flansch bis höchster Punkt Motor)	+ 2 %
8	s s_1	Durchmesser der Befestigungslöcher des Fußes oder Flansches	+ 3 %
9	w_1 w_2	Mitte erstes Befestigungsloch bis Wellenende	± 3 mm
10	b_1	Durchmesser des Zentrierrandes des Befestigungsflansches	bis Durchmesser 230 j6 ab Durchmesser 250 h6
11	d d_1	Durchmesser des Wellendendes (zylindrisch)	bis Durchmesser 48 k6 ab Durchmesser 55 m6
12	h	Achshöhe (Unterkante Fuß bis Mitte Welle)	bis 250 - 0,5 über 250 - 1
13	u u_1	Breite der Paßfeder	h9
14	t t_1	Unterkante Wellenende bis Oberkante Paßfeder	+ 0,2 mm
15		Wellenschulter - Flanschfläche	± 3 mm