Motor control

EPM electrolytic starters for slip-ring motors from 550 to 20,000 kW

EPM Liquid Resistance Starters (LRS)

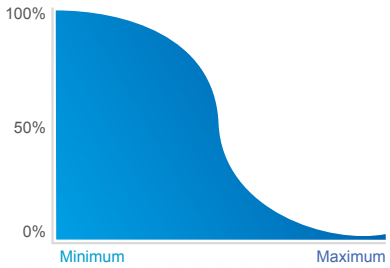
EPM electrolytic starter can be used to start slip-ring motors from 500 kW to 20,000 kW. It will supply the power necessary to drive the motor by resistance variation. Designed for controlled starting and speed control of large slip-ring motors in demanding applications, the EPM liquid resistance starters ensure a smooth progressive acceleration of installations such as: Ventilation, crushing, milling, conveyors, pumps...

The theory behind the starter

The AOIP EPM liquid starter limits the current inrush and maintains the torque at a high enough level to allow the slip-ring motor to start by adding a resistance to the rotor circuit. As this resistance is progressively decreased over the starting period, the motor accelerates smoothly to reach its full load speed. The variation in the resistance is achieved varying the distance between electrodes immerged in the electrolyte.

Optimal starting torque for each application is normally selected by the choice of the initial value of resistance. The resistance offered by the electrolytic solution depends on the concentration of the electrolyte and takes in to account any variations in ambient temperatures.

The AOIP EPM can also be used for speed variation and torque control. Plug braking can also be implemented with this system.



THEY ARE WIDELY USED IN VARIOUS

INDUSTRIES

such as mines, quarries, cement plants, water treatment and power generation and can also be customised for specific applications such as car shredders, plastic mixers and sugar cane cutters.

ADAPTED TO WITHSTAND DIFFICULT SITE CONDITIONS, THE EPM STARTER OFFERS MANY

ADVANTAGES

- **Smooth progressive acceleration**
- **Rugged and reliable**
- **Reduced maintenance**
- **Flexibility**

Operation of starter

AOIP starters for slip ring motors use mobile electrolytic resistance technology.

Each starter comprises a steel tank (one per phase) filled with electrolyte (water mixed with salt, usually Sodium Carbonate) and 3 pairs of immerged electrodes. A stationary electrode fixed to the bottom of the tank and a mobile electrode that travels vertically guided by a nylon rod. The electrodes are in stainless steel (or bronze as an option), shaped in concentric cylinders which merge with each other in the minimum resistance position.

The resistance value depends on the distance between the electrodes, Sodium Carbonate concentration, and electrolyte temperature. The level and temperature of the electrolyte are controlled by a float and thermostats triggering an alarm when set limits are reached.

By varying the distance between the electrodes, we get an accurate variation of resistance, resulting in a supply voltage adjustment and a reduction of starting current and torque.

The starter slowly decreases the resistance, ensuring the smooth starting of the driven machine. At the end of the starting process, the starter is short-circuited.

Description

AN EPM UNIT COMPRISES :

- An electrolytic resistance contained within a tank complete with electrodes.
- A MV enclosure housing the Shorting contactor.
- A LV enclosure which contains the control system.

Tank

The tank is manufactured with heavy duty sheet steel 30/10 to 50/10 mm gauge, stainless steel available as an option, and is normally supplied complete with lifting eye bolts. Tank capacity and dimensions are determined by the motor rating.
The tank is filled through a filling flap and emptied through valves situated at the base of the unit, which are normally locked in the 'closed' position.

Electrolyte

Various concentrations of sodium carbonate are normally employed depending on the initial resistance value required. The electrolyte is supplied in powdered form for easy transport.

Electrode assemblies

A set consists of three fixed and three moving electrodes; polypropylene containers shroud the fixed electrodes to provide adequate isolation between phases.
The cast alloy electrodes consist of concentric cylinders which merge with each other when in their lowest position.
The fixed electrodes, located inside the insulating containers, are fed from an insulated copper bar. Since this bar does not pass through the tank wall, there is no danger of electrolyte leakage.
The moving electrodes travel vertically inside the insulating container, guided by a nylon rod. The assembly is supported by two brass rods fixed to a transversal carrier which is common to all three electrodes and constitutes the neutral point.
Current density is extremely low (typically 1 amp/cm²) resulting in extremely long electrode life.

Electrode control system

Displacement of the electrodes is effected by a motor driven worm screw assembly. This is normally controlled by either a geared motor or a servomotor depending on the application. The standard starting times are 9, 15, 20, 30, 40, 60, 80 and 130 seconds. These are preset during manufacture.

A frequency inverter may also be used for applications where variable starting times are required. A hand wheel is also provided for emergency operation.

Agitator

The agitator is thermostatically controlled to ensure maximum thermal capacity and complete homogeneity of the electrolyte solution.

Control and interlocking:

Limit switches are incorporated to control the geared motor, and to power the shorting contactor which shorts out the residual resistance at the end of the run up time.
The geared motor is fitted with an overload relay, which is used to provide protection in case of the drive mechanism jamming.
An electrical interlock prevents a restart before the electrodes return to the initial maximum resistance position.
If a power failure occurs during starting, the electrodes return automatically to the start position when the supply is restored, so that a new start is possible.

Control panels

The control gear is housed in two separate enclosures. The shorting contactor complete with the rotor terminations are housed in the MV enclosure. A separate housing is provided for the LV controls. The MV enclosure is normally included with the starter, but for higher ratings, it may be supplied in a separate control panel.

Heat exchanger

The principle of the AOIP EPM starter implies a current passing through a resistance. This will induce the heating in the electrolyte due to the Joule effect. The electrolytic solution is cooled using natural convection which is sufficient in most standard applications.
However, in the case of long starting times, large numbers of starts, harsh external conditions or speed variation, the natural convection may not be enough to cool the electrolyte; therefore a heat exchanger will be used to dissipate the extra energy in the electrolytic solution.
The heat exchanger can either be of the liquid type, (cooling water must be available on site), or an air cooler can be used.

EPM DUO Starter

- For starting machines of large duties, or to reduce mechanical stress, it may sometimes be preferable to use two motors totalling the rated power rather than a single one.
- A dual EPM starter is then used, to ensure identical and synchronous acceleration of both motors. The EPM DUO comprises two tanks representing two resistances of equal ohmic values. The two tanks are connected through pipes to guarantee the homogeneity of the level, concentration and temperature of the electrolytic solution in both tanks.
- The electrode drive assemblies are mechanically coupled to ensure complete synchronisation of the movement of the two electrode assemblies, which are driven by a common geared motor. The two resistances are finally shorted out synchronously.

Quotation

Necessary information to quote a starter

Motor data

- Power
- Speed (rpm)
- Rotor voltage and rotor current
- Starting torque

Starter control gear

- IP protection required (IP54/IP55)
- Supply voltage for geared motor
- Control voltage

Machine data

- Type of machine / application
- Speed
- Moment of inertia
- N° of starts per hour / consecutive starts
- Starting time

Operating conditions

- Ambient temperature: Minimum, maximum and average value
- Height above sea level
- Indoor or outdoor installation
- Country of destination

Options and accessories

- Anti-freeze heaters in tank
- Tropicalisation
- Space heater (anti-condensation) in MV cubicle
- Variable starting time (gear motor electrodes replaced by frequency drive)
- Anti-blocking rotor detection
- Heat exchanger (electrolyte-water or electrolyte-air)
- Resistance ratio 100:1 instead of 50:1
- Cable glands
- Brush lifting
- Electrodes position sensor
- Digital panel meter with temperature probe for tank
- Main motor speed variation
- High speed torque variation for shredder (motor electrodes replaced by pneumatic drive)
- Final insertion resistor
- Slip resistor
- Roof
- PLC and programming
- Transformer for LV control cubicle (if 230 V / 50 Hz non available)
- CSA , UL and GOST equivalent certification.

All AOIP EPM liquid resistance starters are manufactured in France in accordance to CE and IEC standards for low and high voltage. A CE certificate is supplied with each starter.

Specifications

Reference	Tank capacity	Dimensions (H x L x w)	Weight (empty tank)	Maximum motor duty			
				Tstarter/ Tnominal = 0,7	Tstarter/ Tnominal = 1	Tstarter/ Tnominal = 1,4	Tstarter/ Tnominal = 2
EPM1/1	1000 l	2000 x 1700 x 1230 mm	720 kg	1600 kW	1100 kW	790 kW	550 kW
EPM2/1	1500 l	2000 x 2120 x 1360 mm	850 kg	2600 kW	1800 kW	1300 kW	900 kW
EPM3/1	3000 l	2290 x 2510 x 1660 mm	1230 kg	5200 kW	3700 kW	2600 kW	1850 kW
EPM3/2				6400 kW	4500 kW	3200 kW	2250 kW
EPM4/1	5000 l	2500 x 2950 x 1860 mm	1650 kg	7800 kW	5500 kW	3900 kW	2750 kW
EPM4/2				13000 kW	9100 kW	6500 kW	4550 kW
EPM1/1 DUO	2 x 1000 l	2000 x 2760 x 1520 mm	1500 kg	2 x 1600 kW	2 x 1100 kW	2 x 790 kW	2 x 550 kW
EPM2/1 DUO	2 x 1500 l	2000 x 2945 x 2030 mm	1800 kg	2 x 2600 kW	2 x 1800 kW	2 x 1300 kW	2 x 900 kW
EPM3/1 DUO	2 x 3000 l	2290 x 3580 x 2560 mm	2450 kg	2 x 5200 kW	2 x 3700 kW	2 x 2600 kW	2 x 1850 kW
EPM3/2 DUO				2 x 6400 kW	2 x 4500 kW	2 x 3200 kW	2 x 2250 kW
EPM4/1 DUO	2 x 5000 l	2500 x 4020 x 2950 mm	2800 kg	2 x 7800 kW	2 x 5500 kW	2 x 3900 kW	2 x 2750 kW
EPM4/2 DUO					2 x 9100 kW	2 x 6500 kW	2 x 4550 kW

Based on maximum power of engine given for 1 start/hour and 3 consecutive starts from cold state. Different models exist to suit the power of the starter(s) and the inertia of the driven machine.
The ranges of EPM starters given above are theoretical only, as ranges will depend on many further non negligible parameters such as starting conditions, starting time and cadenza, torque, type and load of the driven machine, ambient temperature…

The company

Established in 1896 in the nearby of Paris, France, AOIP, an AS-GARD group company, designs, manufactures and markets a wide range of solutions in two different core activities: Electrical motor control and Test and Measurement instrumentation.

With steady efforts and investments in R&D, AOIP solutions are a reference in the fields of motor starting systems and industrial instrumentation and metrology.

Electrical Motor Control

World leader for starters of electrolytic and electronic starters for cage and slipring motors, AOIP has designed and manufactured starters for asynchronous motors for more than 60 years.
Adapted to withstand all weather conditions from extreme cold to tropical environments, more than **500,000 of our starters** have been installed in plants in the cement and mining sector as well as in power plants, pumping stations and manufacturing plants **in over 80 countries.**

- Electrolytic starters
- Electronic starters

- Cage motors
- Slipring motors

- Cement plants
- Mining industry
- Quarries
- Water treatment
- Power generation

- Ventilation
- Crushing and milling
- Conveyors
- Pumps...

Test and Measurement

AOIP also offers you high quality robust instruments, softwares and services to ensure the traceability, calibration, monitoring and validation of process equipment in temperature, pressure, resistance, process signals and humidity.
Our offer meets laboratory as well as production and onsite maintenance requirements, with our own instruments and a selection of products from worldwide renowned manufacturers.

AOIP has two locations:

- A head office near Paris with all commercial activities
- A production facility and warehouse in Normandy

ISO 9001 V2000 certified by AFAQ,
AOIP's quality system guarantees that every step of the manufacturing process is strictly controlled and that our products are of the highest quality.

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