MAK300
AKA Solutions for mining

LIQUID STARTER FOR

FOR BALL & SAG MILLS
from 1 000kW to 12 000kW
Optimal starting for Ball & Sag Mills

AKA solutions

AKA is the leader of liquid starter manufacturers in Europe. Since 2012 AKA focused R & D efforts on improving Liquid Starter performances for Minerals market particularly Ball Mills & Sag Mills. AKA achieved unprecedented performances in the starting of very large MV motors up to 12 000kW.

In order to build the best liquid starter it is necessary to match two targets:

1- To have the best possible resistance Ratio : 300
2- To have a suitable resistance variation the law should be “Non linear”, to speed up a mining Sag & Balls Mills.

High Resistance Ratio: 300

Ratio : Rmax/Rmin = 300

- **Starting Torque**
  Rmax when electrodes are in “Ready to start”, up position.

- **Short circuit Torque**
  Rmin when electrodes are lowered and reach down position, “End of start”

Resistance graph versus travel has two phases:

- Phase 1 75% of travel gain : x10
- Phase 2 25% of travel gain : x30

**Theoretical gain : 300(*)**, **Practical gain : 150**

For vertical LRS competitors graph is a « S » shape and announces a resistance ratio: 80 (nearly 4 times lower).

At the end of starting, the speed must be very near the synchronous speed meaning the residual resistance must be less than 10milioshm. It is necessary to keep torque transition value lower than 200% FLT.

(*) The resistance ratio is measured : at 35VAC/50Hz 25°C

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Non Linear Starting

Ball Mills torque/speed versus time is not linear (see graph). AKA finding is that a non linear resistance profile combined with a large resistance ratio: 300 is much more appropriate to perform the best start up for large mining mills (Ball & Sag Mills).

Gearbox and mill manufacturer recommendation is to avoid mechanical shocks due to:
- Excessive starting torque
- Short circuit torque spike

AKA non linear starting prevents all these events.

There are also two others phenomena which can damage the mill:
- Frozen load
- Starting acceleration too fast: smash the mill body

**Starting Torque**
Must be between 75% to 125% FLT.
Typical 100%FTL

**Short circuit Torque**
At the end of starting the speed must be very close to synchronous speed that means the residual resistance must be less than 10miliohms. This is necessary to keep torque transition value lower than 200% FLT.
Tank

Four tanks to cover the range made out of steel or Stainless steel (option).
Tanks could be custom designed for specific applications.
Tank wall thickness: 3mm
Volume: 2 500L, 4 500L, 6 000L, 2 x 6 000L
Tank Protection: IP56

Panel

Two types of panels to suit the shorting contactor:
Panel is composed by two sections:
• LV section for PLC and relays and
• HV section for shorting contactors
Protection IP56

Electrodes

Electrodes are made in cast alloy for heavy duty applications and high ratio applications

Electrode drive mechanism

It is the heart of the liquid starter. It consists of a geared motor, a screw type drive moving a set of mobile electrodes.
The drive mechanism is a mechanical assembly independent of the tank that can be taken off for maintenance.
Applications

**Dual Starters**

For large applications it is quite usual to find two or three motors driving a common load. The conditions for proper operation are the following:

- **Common resistor**
- **Resistance variation strictly identical:** electrodes position synchronized by chain.
- **Common short circuit contactor**

Dual drives are designed either with 2 tanks or with 1 single tank containing 2 sets of electrodes.

**Slip recovery system**

AKA Liquid Resistance Starters are designed to work with Slip Energy Recovery systems.

**Heat exchangers**

This option is available for any application that requires frequent starts that generates substantial heat in the tank.

**AKAMAS**

**Torque and Speed real time measurement**

AKA developed this powerful digital system able to measure with great accuracy the rotor currents over the entire frequency range (50Hz or 60Hz to 0.1Hz during startup) as well as motor speed. It computes motor slippage and frequency too. The AKAMAS is an unparalleled device which shows exactly how the motor performs during start up. It interfaces with the LRS. The starting torque or current can thereby be adjusted to safely meet the requirements.
## MAK300 RANGE

### Single drive

<table>
<thead>
<tr>
<th>Starting Characteristics</th>
<th>Ambient Temperature</th>
<th>MAK 25</th>
<th>MAK45</th>
<th>MAK60</th>
<th>MAK2x60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting Torque= 120%</td>
<td>40°C</td>
<td>5 000W</td>
<td>7 000W</td>
<td>9 000W</td>
<td>10 000W</td>
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<tr>
<td>Starting Time = 20sec</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Starting Torque= 120%</td>
<td>40°C</td>
<td>4 000W</td>
<td>6 000W</td>
<td>7 500W</td>
<td>8 000W</td>
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<tr>
<td>Starting Time = 30sec</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Starting Torque= 120%</td>
<td>50°C</td>
<td>3 000W</td>
<td>5 000W</td>
<td>6 000W</td>
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</tr>
<tr>
<td>Starting Time = 20sec</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starting Torque= 120%</td>
<td>50°C</td>
<td>2 500W</td>
<td>4 000W</td>
<td>5 000W</td>
<td>6 200W</td>
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<tr>
<td>Starting Time = 30sec</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume</td>
<td></td>
<td>2 500 L</td>
<td>4 500 L</td>
<td>6 000 L</td>
<td>1 2000 L</td>
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</table>

### Dual drive

<table>
<thead>
<tr>
<th>Starting Characteristics</th>
<th>Ambient Temperature</th>
<th>MAK45 DUAL</th>
<th>MAK60 DUAL</th>
<th>2xMAK45 DUAL</th>
<th>2xMAK60 DUAL</th>
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</thead>
<tbody>
<tr>
<td>Starting Torque= 120%</td>
<td>40°C</td>
<td>2 x 5 000kW</td>
<td>2 x 10 000kW</td>
<td>2 x 5 000kW</td>
<td>2 x 10 000kW</td>
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<td>Starting Time = 20sec</td>
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</tr>
<tr>
<td>Starting Torque= 120%</td>
<td>40°C</td>
<td>2 x 4 750kW</td>
<td>2 x 8 000kW</td>
<td>2 x 4 750kW</td>
<td>2 x 8 000kW</td>
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<tr>
<td>Starting Torque= 120%</td>
<td>50°C</td>
<td>2 x 4 125kW</td>
<td>2 x 8 000kW</td>
<td>2 x 4 125kW</td>
<td>2 x 8 000kW</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Starting Torque= 120%</td>
<td>50°C</td>
<td>2 x 3 125kW</td>
<td>2 x 6 200kW</td>
<td>2 x 3 125kW</td>
<td>2 x 6 200kW</td>
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<tr>
<td>Starting Time = 30sec</td>
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<tr>
<td>Volume</td>
<td></td>
<td>4 500 L</td>
<td>6 000 L</td>
<td>9 000 L</td>
<td>12 000 L</td>
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</table>

*3 starts from cold and 2 starts from hot*
### MAK300 DIMENSIONS

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>D</th>
<th>L</th>
<th>H</th>
<th>H*</th>
</tr>
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<tbody>
<tr>
<td>MAK25</td>
<td>1 837 mm</td>
<td>2 304 mm</td>
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<td>MAK45</td>
<td>2 037 mm</td>
<td>3 055 mm</td>
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<td>2 051 mm</td>
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<tr>
<td>2xMAK45</td>
<td>2 037 mm</td>
<td>3 055 mm</td>
<td>1 964 mm</td>
<td>2 051 mm</td>
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<tr>
<td>MAK60</td>
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<td>3 055 mm</td>
<td>1 964 mm</td>
<td>2 051 mm</td>
</tr>
<tr>
<td>2xMAK60</td>
<td>2 037 mm</td>
<td>3 055 mm</td>
<td>1 964 mm</td>
<td>2 051 mm</td>
</tr>
</tbody>
</table>

H* Dimension with "sun roof" option
Since its creation in 1988 AKA continuously innovated in order to strengthen its position as a significant European manufacturer of power electronics and motor control. By focusing on Research and Development, AKA has built up know-how in the control of electric motors. The developed products are competitive on national and international markets and exports account for more than 85% of turnover.

More than 800 AKEP are in operation worldwide in Cement and Mine plants

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