

# Motor Starting



## Synchronous motor starting

Synchronous motors are not self-starting because the stationary rotor's constant magnetic field creates a pulsating torque when interacting with the rotating stator field, which doesn't produce rotation. To start, the motor is first accelerated to near synchronous speed, and then DC field current is applied as it reaches this speed, allowing it to sync and rotate properly.

### Pony Motor

- **Motor Type:** The pony motor is an induction motor directly coupled to the synchronous motor.
- **Pole Configuration:** It has fewer poles than the synchronous motor to ensure efficient speed escalation.
- **Function:** Brings the synchronous motor's rotor up to synchronous speed.
- **Activation:** Once synchronous speed is reached, the DC supply to the rotor is switched on.
- **Magnetic Lock-in:** This action causes the rotor's and stator's magnetic fields to synchronize.
- **Operation:** The synchronous motor then operates at synchronous speed.
- **Decoupling:** After synchronization, the pony motor is decoupled from the synchronous motor.

### DC Machine

- **Coupling:** A DC machine is directly coupled to the synchronous motor, similar to a pony motor.
- **Initial Function:** Initially functions as a motor to accelerate the synchronous motor's rotor to synchronous speed.
- **Transition to Generator:** Upon reaching synchronous speed, the DC machine transitions to act as a generator.
- **Field Current Supply:** As a generator, it supplies the field current to the rotor.
- **Magnetic Lock-in:** This enables the rotor's magnetic field to lock in with the stator's magnetic field.
- **Continuous Operation:** The synchronous motor then continues to operate at synchronous speed.
- **Dual Role:** The DC machine serves both as a motor to start the synchronous motor and as a generator to supply field current.

### Damper Windings

- **Structure:** Synchronous motors are equipped with squirrel cage windings on the rotor, known as 'damper windings.'
- **Purpose:** Damper windings are not designed to carry load current but assist in starting the motor.
- **Starting as Induction Motor:** The synchronous motor starts as a squirrel cage induction motor using methods like DOL, Star-Delta, or Autotransformer.
- **Activation of DC Supply:** Once the rotor nears synchronous speed (around 95%), the DC supply to the rotor is switched on.
- **Synchronization:** The rotor then synchronizes at 100% synchronous speed.
- **Magnetic Lock-in:** The rotor's magnetic field locks in with the stator's magnetic field, allowing stable operation.
- **Continuous Operation:** Post lock-in, the synchronous motor operates continuously at synchronous speed.
- **Commonality:** Damper windings are a prevalent method for starting synchronous motors.