



Soft Starters for Electric Motors

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A Brief Explanation of Electrical Motor Soft Starters

Potential Motor Damage

The sudden power surge that starts a motor can damage the electrical parts of the motor. The inrush of current can create more motor wear and thus require additional maintenance. Motor life also will decrease. Motor soft starter devices were developed to reduce mechanical wear and increase motor life.

Soft Starters

A soft starter can be any device that reduces the starting torque delivered to the power train.

Mechanically, this can be a clutch, fluid drive, magnetic coupling or any other device that allows the motor to start while slowly applying the shaft torque to the load.

Electrically, a soft starter is a device that decreases the torque by reducing the voltage by changing the motor connectivity. The connectivity of the motor windings is altered so motor torque is reduced at startup. This alteration requires that the motor is designed to start in such a way. This is not a universal modification for modern motors, however.

Output torque is proportional to the square of the applied voltage at a fixed frequency. Therefore, changing the terminal voltage will vary the output torque. Reducing terminal startup voltage can be accomplished in several different ways.

One of the most frequently used methods of reducing the voltage is to

use an autotransformer that drops the motor voltage during motor startup. When the motor has reached full capacity, the transformer is switched out so the motor receives full running voltage. The method described is called reduced voltage auto transformer starting. Although reduced voltage auto transformer starting is categorized as soft starter, the solid state reduced voltage starter has become the common soft start device.

Solid State Reduced Voltage Starter

Solid state reduced voltage starters use high speed switches called silicone controlled rectifiers. These silicone controlled rectifiers switch the input power on for a portion of the sine wave. Consequently, the root mean square voltage supplied to the motor is reduced in proportion to the time the silicone controlled rectifier is switched on. This switching is known as gating. As the time the silicone controlled rectifiers are switched on is increased, the root mean square voltage increases until the motor is brought to full load.

Once the motor is at full voltage, the soft start system is no longer needed and is bypassed. A bypass contact moves the power around the silicone controlled rectifiers directly to the motor. Using the bypass device is beneficial since silicon controlled rectifiers are not perfect conductors. This imperfection causes the silicone controlled rectifiers to produce 1.5 watts of heat per running load amp per phase. Unless the silicone controlled rectifiers are bypassed, they would prematurely wear out because of this heat.

References

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