

## MP-08 : NUMBER OF STARTS

A starts-per-hour counter is occasionally requested as part of a motor protection scheme. The NEMA standard for motors and generators has a number-of-starts specification that is probably the historical root of these requests; however, the thermal modelling techniques used in modern motor protection eliminate the need for a counter that cannot discriminate between a no-load start and an attempt to start a motor with a locked rotor.

Motors built in accordance with NEMA standard MG 1-1993 are capable, without injurious heating, of two starts from cold or one start from hot with an inertial load ( $Wk^2$ ) equal to or less than a specified value. The energy required to bring an inertial load up to speed does not depend on time; consequently, starting time is not specified. During acceleration, the kinetic energy delivered to the rotating parts is equal to the energy loss in the rotor. Since the starting interval is small with respect to the thermal time constant of the motor, the change in cooling during starting is not significant (adiabatic process) and the number-of-starts specification is actually a thermal capacity requirement for motor rotors. A motor protection relay with a thermal model that uses the thermal time constant of the motor can accurately track used thermal capacity through starting, running, overload, and cooling cycles. This allows a motor to be used to its design limit without injurious heating or nuisance trips. By contrast, a number-of-starts counter can unnecessarily prevent a start in a lightly loaded application and it can fail to provide protection in a heavily loaded application.