

SURGE TEST FOR INDUCTION MOTORS

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The purpose of the surge test is to apply short rise time and relatively high-magnitude voltage impulses to stress the terminal-end insulation to check whether the motor can withstand the surges encountered in service. With a short rise-time impulse voltage, a significant percentage of the voltage is applied across the turn, phase, and groundwall at the terminal end of the stator, unlike the insulation resistance or high-potential tests. The schematic of the surge generator and motor test set up is shown in Figure 1. The capacitor is charged to predetermined level and discharged into series resistor-inductor-capacitor circuit that includes the stator winding. This results in an

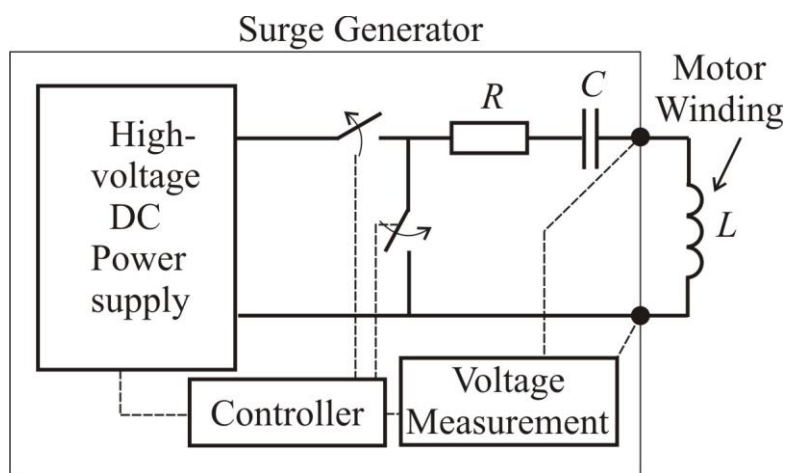


Figure 1 The schematic of a surge test circuit and setup

underdamped oscillation at the resonant frequency are given by $f = 1/(2\pi\sqrt{LC})$, where L and C are the equivalent inductance and capacitance of the series circuit. If the voltage applied to the weakened terminal-end turn insulation is high enough, it will result in arcing (shorting) between the turns and a decrease in L . The increase in the resonant frequency results in a shift in the surge waveform to the left

as the impulse voltage magnitude is gradually increased, providing an indication of weak turn insulation. It can also provide indications of weak phase and groundwall insulation near the terminal end. However, it is a pass-fail test and cannot provide a quantitative indication of the terminal-end insulation condition. The surge partial discharge test observes partial discharge activity in the stator insulation with a short rise-time voltage impulse applied to the complete stator. This test is considered in this article because partial discharge activity in the terminal-end turn and phase insulation, where the voltage stress is applied, can provide indirect indications of weak insulation with air pockets. As has been discussed in a number of publications, the test is capable of providing indications regarding end winding turn and phase winding insulation defects or degradation leading to failure. It is evaluated under the expectation that it can provide a quantitative indication of the turn or phase insulation condition. The surge partial discharge test is mainly applied for qualifying inverter-led low-voltage motors.

Literature:

1. Daewoong Choi, Tae-June Kang, Sang Bin Lee Stator insulation testing for appliance motors with aluminum windings // IEEE Industry Applications November/December 2018, Vol.24, No.6, pp. 14-24.