Exhaust Fan Fires

Fires caused by small exhaust fans commonly found in residential bathrooms have increased over the last 10 years. Frequently, these fires have been attributed to Broan-NuTone exhaust fans equipped with Jakel motors. In “Ventilation Fan Fires: Overheated Windings Lead to Failed Thermal Limit Switch,”¹ an article in Fire Technology, the authors provide why design changes implemented in Jakel fan motors manufactured between 2000-2003 have led to higher incidents of failure and fires.

Exhaust fan fires can occur when lint builds up on the fans and the fan motor begins experiencing symptoms associated with the end-of-its-useful-life: the bearings in electric motors begin to wear over time and run with increased friction. The increased friction causes heat that leads to a progressive failure of the bearing. The surface of the motor also collects lint that increases the temperature of the windings. The insulating effect created by the coating of lint, combined with the increased heat caused by a worn bearing can ignite the lint. The fire then spreads to surrounding combustibles.

In the Fire Technology article, the authors identify two significant design modifications in Jakel motors that resulted in winding degradation, ground faults, arcing and fires. The first modification was a reduction in the winding size wire from 26 AWG aluminum winding wire to the reduced size of 27 AWG aluminum. The reduced wire size caused an increase in resistance and a corresponding increase in power consumption and heat production. A 20 percent increase in resistive heating across the windings happened due to the wire gauge reduction, according to the authors.

In addition to the wire size reduction, around 2000, Jackel Motors began using a thermal cutoff (TCO) manufactured by Tamura. Through forensic analysis and laboratory testing, the Tamura TCO in the Jackel Motors was found unreliable at opening the circuit and cutting off the electricity to the motor when exposed to temperatures above its designed cutoff temperature. There were a number of contributing factors that could cause the Tamura TCO not to function properly in the 2000 and newer Jackel motors. One reason may have been the Tamura TCOs not being installed in the Jakel Motors pursuant to Tamura’s instructions. Tamura specified a 90 degree bend to the lead wire coming out of the TCO. However, the authors found evidence suggesting the lead wire was being bent back around 180 degrees against the body of the TCO. A sharp bend in the TCO lead wire could damage the epoxy seal at the end of the TCO, allowing air to enter the TCO causing oxidation on the fusible thermal link.

Another reason suggested for the failure of the Tamura TCO was an exposure to excessive heat. Prolonged, increased heat exposure could cause the resin flux to harden that could prevent the TCO from opening. In multiple forensic investigations and laboratory testing, the Tamura TCO inconsistently opened when exposed to temperatures above its specified cutoff temperature (136 degrees C).

When handling exhaust fan fires, determine if the product was a Broan-NuTone fan. If it is, determine the age of the fan. Check to see if the fan failure mechanisms match those listed above.