

COMBINATION EFFECT OF FRETTING AND CORROSION ON BOLT-TYPE POWER CONNECTORS

Guo-Ping Luo Liang-Jun Xu Ji-Gao Zhang

Research Lab of Electric Contacts

Beijing University of Posts & Telecommunications

Beijing 100876 China

ABSTRACT

Through investigation on failed bolt-type power connectors applied in China, serious contamination and low contact force have been found [1][2]. Further studies show that combination effect of fretting and corrosion greatly aggravates connector's performance. Evidently electrochemical corrosion takes place and thick white corrosion products are observed between aluminum connector and steel flat washer. XPS (X-ray photoelectron spectroscopy) analysis shows that it mainly is the compound of Al_2O_3 and its hydrate. Crevice corrosion among nut, spring washer and flat washer is also found. Corrosion not only decreases mechanical strength, but also reduces the real load-bearing area of spring washers. Meanwhile, several spring washers and connectors appear obvious cracks on their maximum tension stress position, which show the evidence of stress corrosion. This kind of corrosion may develop very soon after a period of latent time and quickly cause the loss of contact force. Hence it is much more dangerous than other kinds of corrosion.

Reduction of compressing force makes fretting on contact interface to be easier. Analysis shows there are different kinds of micro-motion appearing on contact interface, about one-third of samples display obvious fretting tracks. Therefore, tarnish film accumulated by oxide debris and dust forms on contact surface. Connection resistance increases evidently, corresponding temperature rise increases and corrosion is accelerated. This vicious cycle may finally cause the failure of the connectors. Therefore, appropriate protective measures are needed in harsh environment.

Some surface detection devices such as SEM (scanning electronic microscope)/EDS (energy dispersive spectroscopy) and XPS are used to observe morphology of electric contact interface and analyze compound formation of corrosion products. Metallographic examination is also made to analyze corroded products and metallurgical structure.

Keywords: bolt-type power connector, fretting, electrochemical corrosion, stress corrosion