

Service Reliability Estimation of Degrading Failure Modes: Wheelchair Batteries

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Abstract

For the samples of a multi-state product returned from service due to a degrading failure mode and claimed by users and/or technicians, failure time estimation is necessary for reliability purposes. This paper presents the transition concept of the product into binary-state in order to estimate real failure time of its field samples. Physical property of the product is linked to its degradation over service aging time in order to define product failure. Then, failure time of field samples are estimated in terms of their physical properties and ages based on known damage model. The most consistent model has also been obtained by least square method. According to comparative study on failure criteria defined by manufacturer and users, a huge gap is revealed between their reported failure times. The results of capacity testing on powered wheelchair batteries are presented to validate our proposed approach.

Key words: Reliability, Degrading failure modes, Wheelchair batteries, Accelerated testing

1 Introduction

Used samples of a product returned from service due to a degrading failure mode claimed by users and technicians, potentially possess valuable information about how they have degraded and been used in field. Qualitative explanation of such samples as multi-state (including excellent, good, fair and poor states) is not sufficient for an exact reliability analysis. In addition, such explanation is not able to describe probable gap between manufacturer and user's criteria to report a failure. Accordingly, a quantitative approach is needed to fulfill the above requirements, and to compare different versions and available brands of a product in the market as well.

For the samples returned from service because of a catastrophic failure mode, their ages should be considered as their failure times. Work order forms are the main sources of catastrophic field failure data