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Evaluation of an actuating mechanism for the electrical industry

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ABSTRACT

A class of electrical devices reacts to fault conditions by disengaging from the circuit.
A particular sub-system of the device, the actuating mechanism, was identified as having potential for improvement in the first pass yield achieved for its manufacturing and assembly process. The critical characteristic of the actuating mechanism, its sensitivity or “lock load”, was found to be within functional limits in 94% of mechanisms tested at the end of the production line. An increase in this value to a tentative target of 99% was proposed. Such an increase in first pass yield has typically been shown to translate into a financial advantage, offsetting any investment required for its implementation. It was conjectured that a modification to the actuating mechanism design might be indicated to enable the target to be achieved.

In order to examine the feasibility of improving the process, models were developed to represent two variations of the current actuating mechanism design. The models were implemented by means of vector loop analysis, and were used to predict the lock load distribution of the mechanisms. The accuracy of the models was first validated by comparison with parametric CAD models of the mechanisms, and then with actual lock load distribution data derived from measurement of production samples. An interactive computer application was developed to facilitate the manipulation of individual model variables within their tolerance bands, and to evaluate the effect of such manipulation on the calculated value of the lock load. A Pareto analysis was conducted to identify the independent component variables that were the most critical for control of the correct functioning of the mechanism, and thus where the priorities lay for further optimisation.

The results were analysed, and a comparison of the strengths and weaknesses of the two existing designs suggested that a third variation of the mechanism had the potential of achieving the process yield target.

The mathematical model was adapted to predict the behaviour of the third actuating mechanism variation. The first pass yield predicted by the new model was 99.36%. The implementation costs of the new design were estimated, and offset against the potential savings resulting from the improved first pass yield. A payback period of 2.7 years was projected.

It was recommended that the accuracy of the critical data used in the analysis be refined by means of larger scale testing, and that ancillary recommendations stemming from the Pareto analysis be implemented. Finally it was concluded that based on the currently available data, the design modifications proposed for the actuating mechanism were both financially and practically feasible, and should be implemented.