Priority and Sensitivity Analysis of Failure Mode Improvement of Mechanical System

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Abstract: Failure mode is an analysis method used to determine potential failure modes and their causes. Specifically, through the implementation of FMEA, the weaknesses of the product can be found before the product design or production process is truly realized, and the product defects can be determined at the prototype stage or before mass production. FMEA is the first set of analysis mode formed by NASA. FMEA is a practical method to solve problems, which can be applied to many engineering fields. At present, many automobile manufacturers and electronic manufacturing service providers (EMS) in the world have adopted this mode to manage and monitor the design and production process. In the product design stage and process design stage, it is a systematic activity to analyze each process one by one, find out all potential failure modes, analyze their possible consequences and take necessary measures in advance to improve product quality and reliability.

1. Objective

Through the analysis of the potential failure modes in the product design process and manufacturing process, the causes and mechanism of their occurrence, and the evaluation of their risk degree, the necessary measures shall be taken for the failure modes with large risk sequence to prevent the occurrence of failure modes. If the customer has special requirements, the implementation shall be in accordance with the customer's requirements.

2. Working Procedure

Sequence the frequency, severity and detection level of the event: The severity is to evaluate the impact of possible failure modes on the product, with 10 being the most serious and 1 being no impact; The frequency of the event should record the specific failure cause and mechanism how often and how often. If it is 10, it means that it is almost certain to happen, and the process capacity is 0.33 or ppm is greater than 10000.

2.1 Evaluate the probability of the proposed process control detection failure mode.

If it is showed in figure 1, it indicates that it cannot be detected, it indicates that it has passed the defect detection of the current process control. Calculate the risk priority number, RPN). RPN is the product of event frequency, severity and detection level, which is used to measure possible process defects, so as to take possible preventive measures to reduce key process changes and make the process more reliable. First of all, the process correction should focus on the most concerned and the most risky links. The worst case of RPN is 1000, and the best case is 1. The best way to determine where to start is to use the Pareto Diagram of RPN to screen those projects whose cumulative level is far lower than 80%. Recommend responsible solutions and completion dates. The ultimate goal of these recommendations is to reduce one or more levels. For some serious problems, rescue plans should be considered from time to time, such as the failure mode impact of a product with a risk level of 9 or 10; the occurrence and severity of a failure mode / cause event of a product with a high RPN value, etc. After all rescue measures are determined and implemented, a stable period is allowed, and then the frequency, severity and detection level of revised events should be reconsidered and sequenced.

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Figure 1 An example for EFMEA model

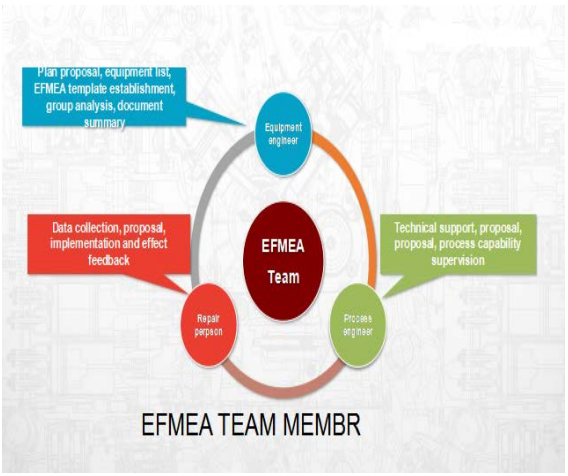

Figure 2 Set up EFMEA Team

3. An Example of FMEA Analysis of Mechanical Products.

After the NPI conference, a FMEA team can be set up (figure 2), including the production director, process engineer, product engineer, test engineer, quality engineer, material purchaser and project manager. The quality engineer leads the team. The goal of FMEA's first meeting is to strengthen the initial manufacturing process.The quality control points in TPI) and the team also have a deeper understanding of the products. Generally, the main tasks during and after the first meeting include:①The process and production engineer shall introduce the process flow chart step by step, and the process function and requirements of each step shall be defined.② The team will discuss and list all possible failure modes, all possible impacts, all possible causes and current process control of each step, and rank these factors by RPN. For example, screen.For all possible failure modes of missing solder paste, the existing process control is stencil.Design, regular cleaning of templates, visual inspection and preventive maintenance of equipment maintenance, PM) and solder paste viscosity check. The process engineer includes all the current control points in the initial MPI, such as template design research, template cleaning, visual inspection frequency, solder paste control, etc. The FMEA team needs to review the existing production line in accordance with the control nodes in the MEA document, and comprehensively consider the current production line setting and other issues. If the drying box is located, the audit team suggests that it should be placed in a fine pitch device Place machine) to facilitate the processing of humidity sensitive components.

4. FMEA Follow Up Activities

After the general structure of NPI is completed, follow-up meetings of FMEA can be held. The meeting includes a comprehensive consideration of the existing process control and quality report of NPI's general structure. The FMEA team re ranks the RPN. In each step, the first three major defects are considered first, and the recommended scheme, responsibility and target completion date are determined. For surface mounting process, the first two defects are solder ball defect and tombstone defect. The following solutions can be recommended to process engineer: For solder ball defects, check the stencil design and reflow profile. Check screen printing accuracy and placement accuracy of pick and place machines. For tombstone defects, check the screen printing accuracy and the placement accuracy of pick-up and place machines; check the return direction; research terminal. Possibility of contamination. According to the Research Report of process engineer, the rapid rise of reflow temperature is the main cause of solder ball defect. Pollution is the possible cause of tombstone defects. Therefore, a design experiment (DOE) is established for the next design validity verification test structure. The design experiment shows that a supplier's components are more likely to have tombstone defects, so the supplier is required to make further investigation and correction. Any changes to product design, application, environmental materials and production

assembly process must be updated in the corresponding FMEA documents. FMEA update meeting is a daily activity before mass production of products. The projects that are not questioned in the FMEA stage are naturally kept on the site of mass production. Pick and place machine accuracy is a major consideration after the process audit. The equipment department must verify the CP / CPK of the layout machine and conduct training to deal with the wrong printed circuit board. The FMEA team needs to closely monitor the first trial production, and the quality verification of the production line should be carried out at the same time. After the trial production, FMEA needs to hold a meeting to check the existing quality control and trial production quality report, mainly to solve the first three problems in each link.

5. Conclusions

Using FMEA management model to identify risks in early projects can help mechanical equipment manufacturers improve production capacity and efficiency, and shorten the time to market of products. In addition, through this mode, all kinds of experts can test the production process from all angles, so as to improve the production process. The recommended scheme should be correct correction, and the benefit is considerable. In order to avoid defects, the process and design need to be changed. Use statistical method to study the production process, and constantly feed back to the appropriate personnel to ensure the continuous improvement of the process and avoid defects.

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