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Construction FMEA analysis of industrial sewing machines

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The succes on the market is strongly depending on the quality of the products offered to the customers. This quality include technical properties, cost and delivery terms too. The increasing complexity of product involves sistematical methods to the continuous evaluation of the real quality. Failure Mode and Effect Analysis (FMEA) is a very usefull tool for these purposes. This paper presents an application of the FMEA for the sewing machine Veronica, produced by U.M. Cugir.

Introduction

With all the well known advantages of the FMEA this method is not used in a large scale in most of developed country's industries for designing and planning because of the extra effort which is required by this method.
The fact whether the utilisation of FMEA is useful or not can be appreciated by results. In many examples has been found that in the case of consequent application of the FMEA, the results are better than expected.

FMEA method for preventive quality assurance

Due to the increasing number of the qualified workers in the industries in the last ten years, must be assured the strenghtening of the thinking procedure as well, in order to overtake the advantage in know-how which has been realized in the world. Such a - useful and simple - procedure is FMEA. This method gives the possibility to analize products and manufacturing processes in the early stages of designing, in order to eliminate the possible faults and defects which may occur during the exploatation. This is very important mostly when we are thinking about the costs of parts produced, for example in automobile industry.
May be asked, what are the advantages of FMEA? Firstly, it permits a realistic appreciation of the conformity of products and services with the market and customer needs. FMEA improves the colaboration not only between the members working together inside the company but also between externals such as suppliers and customers. This method has a great effect on confidence develeopment as well. It is an excellent instrument for teaching (training) and allows the reduction of the chronic lack of high qualified personnel. Of course like many other methods, it has its disadvantages concerning the application. These are the great demand of time and money which make this method

unuseable in efficient conditions when a rapid development process of a product is needed or in the case of small batchnumber production.
Also it can not be identified all the failure modes that can lead to unsucces.
Another disadvantage of FMEA is that however there are given recomandations for standards and values of risc numbers, it contains a large amount of subjectivism, so can not be assured that the stated weight of failure chain corresponds with the reality.

FMEA for constructive improvement of the Veronica industrial sewing machine

As a result of one study which was effectuated between different industrial sewing machine users, as critical points from point of view of failure frequence was found the rack pinion from the thread guiding mechanism, cam control subassembly, automatic pulp meter subassembly and the cutting-smoothing subassembly. The defects associated with the above mentioned subassemblies were analized by FMEA method A part of this analisys can be followed in Figure 1.In conformity with the risk priority numbers (RPN) depending on the severity, occurance and detection, the six most grave failures, in descendent order were:

1. wear and fracture of the bevel gear drive tooth (378)
2. fracture or wear of the thread guiding mechanism (150)
3. wear of the trapezoidal vee belts in the motor-main ax drive (189)
4. clearance in the rack pinion transmission (148)
5. clearance in the cam control subassembly (144)
6. wear of the opening from the cutting-smoothing subassembly (144).

Figure 1. FMEA on Veronica sewing machine

Part name(s)	Function	Potential failure mode	Effect(s) of failure	Cause(s) of failure	Existing conditions	O	S	D	RPN= O.S.D	Recomended action(s)
1.Needle	Sewing	11. Needle breaking	111. Not sewing	1111. The needle hits the needle's plate-there is no sinchronism between the vertical movement of the needle and the material movement system.	Detection by looking. Readjust.	8	5	2	80	
				1112. There is a large clearance in the neeedle holder guiding bushing: - hits in the needle's plate -hits the nose of thread guiding stick	Detection by looking. Bushing replace-ment .	9	4	2	72	Designing the bushing from ceramic material.
		12.High surface roughness at the opening	121. Thread rupture	1211. The needle's opening is badly processed	Detection by looking. Needle replace-ment.	5	2	2	20	
2. Needle-holder arm	Rectilinear and reciprocating moving of the needle.	21.Sticking	211.Not good for the purpose	2111.The arm is bending or sticking.	Detection by looking. Arm replace-	3	2	2	12	

					ment.					
				2112. Sticking of the eccentric	Detection by looking. Replace-ment..	4	2	3	24	

The eliminative and preventive activities against this failures are given in the column of recomended actions. For example in the case of the needle's plate a corner fillet on the upper outline of the opening can lead to the prevention of its deterioration (when the needle hits the plate, it can slide in the hole, because the elasticity of the needle allow this deformation).

Summary

The application of the FMEA for different elements and parts - which are to be defected frequently, involves grave consequences on the good working of the sewing machine - allowed the formulation of eleven suggestions for constructive modifications.

The economical analyses showed that the realisation of the suggested modifications can lead to a 19 % reduction of material costs and 24 % decrease in production costs.

References

[1] Pfeifer, T.: Qualitätsmanagement, Carl Hanser Verlag München, Wien, 1993.

[2] Tlach, H.: FMEA, ein Strategisches Element des Qualitätsmanagement-Systems, Qualität und Zuverlässigkeit, 38 (1993), nr.5., pp. 278-280.

[3] Osanna, P.H.; Prostrednik, D.: The role of Precision Engineering in Intelligent Manufacturing Systems, Second International Workshop on learning in Intelligent Manufacturing Systems, Budapest, 20-21. April 1995, pp. 831-841.

[4] Kerekes, L.; Nicoara, A.; Naghi, A.: Utilizarea metodei FMEA-produs la analiza masinii de cusut Veronica

[5] Johanyák Zsolt Csaba: Számítógéppel segített hibamód és -hatás elemzés, micro CAD '94 - Nemzetközi Számítástechnikai Konferencia, Miskolc, 3. March 1994 , pp. 60-65.

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