Analysis for Manufacturing Process of Joint Flange

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Abstract- In this study, a method is proposed which processes the flange and the flange which connects it the commercial vehicle. Companion Flanges can be supplied as individual components or as assemblies with Universal Drive shafts. When the flange was brought in use in the commercial vehicles, it was seen that because if heavy friction, the part is deteriorating. To prevent this issue, a design was made which was further manufactured for accomplishing the goals of this study. When the product was ready, it was tested on CMM machine to find any type of error between the designed and manufactured product. The outcome obtained from the CMM machine showed a very small percentage of error. The new manufactured product had comparatively less amount of friction loss.

Keywords- Flange Coupling, CMM Report, Process Flow, Lathe Machine, DFM

I. INTRODUCTION

A companion flange is a flange that corresponds to another flange. Having bolt holes that align with another flange is a trait of this type of flange. Companion Flanges can be supplied as individual components or as assemblies with Universal Drive shafts. It allows connection of a flange yoke to another type of connection, for proper torque transfer. The overall objective of this paper is to design and analyze a companion flange for torque transmission. This work deals with the replacement of carbon steel material companion flange with a stainless-steel companion flange. In this present work an attempt has been to estimate the deflection, stresses under subjected loads using FEA.

A Process Failure Mode Effects Analysis (PFMEA) is a structured analytical tool used by an organization, business unit, or cross-functional team to identify and evaluate the potential failures of a process. PFMEA helps to establish the impact of the failure, and identify and prioritize the action items with the goal of alleviating risk. It is a living document that should be initiated prior to process of production and maintained through the life cycle of the product. PFMEA is a methodical approach used for identifying risks on process changes. The Process FMEA initially identifies process functions, failure modes their effects on the process. If there are design inputs, or special characteristics, the effect on end user is also included. The severity ranking or danger of the effect is determined for each effect of failure. Then, causes and their mechanisms of the failure mode are identified.

II. LITERATURE REVIEW

(Dewangan and Verma, 2020) [22]Companion flange is used as assembly part with universal drive shafts in vehicle transmission system. It allows connection of a flange yoke to another type of connection, for proper torque transfer. The existing design of companion flange incurred wobbling problem during transmission testing. After dimensional checking of part found spline or broaching shifted from its centre position as shown in report picture.

(Hu *et al.*, 2019) [21]A simple method named singularity length method (SLM) with a key parameter singularity length ‘as’ is proposed to estimate the shear stress distribution at the V-notch corner. For tube-flange welded joints (TFWJs) with 135 weld toe notches, the singularity length ‘as’ is observed to be determined by different geometries and is sum- marized into concise formulas. A rapid calculation method of the mode III notch stress intensity factor (NSIF K3) without any FEA process is presented based on the SLM.

(Raj, Dayalan and Shrivardhan, 2018) [14]deluged and overflowing composition published in knuckle joints and its importance in automobile industries. Achieving manufacture excellence through better quality and productivity is the objective lens of many industries in present. Every governance is trying hard in the process of customer retention (Voice of The Customer VOC and Critical To Quality CTQ) by controlling costs and obtaining high productivity. A voluminous and significant measure of research article were referred in which all the papers concentrated one and only on the final product with some investigation on dimensional accuracy, which includes - Cycle time reduction, degree of doubt and the proper placement of the knuckle part.

(KondaiahBommisetty and MahendraKenchegowda, 2016) [11]Structures in aerospace are often connected by different types of bolted flange joints. A basic function of bolted joint is to provide adequate joint strength, stiffness and sealing to minimize leakages. The capability of the joints is determined by analysis, augmented by testing. Therefore accurate evaluation of bolt force in a bolted joint under external loads is a fundamental requirement in bolted joint design. Different types of bolted joints such as conventional back to back flange, stepped flange (Dogleg flange), triple stack flange are generally used to connect casings, bearing housings, rotors of gas turbine aero engine. Bolted joints are complex to design and difference in behavior is expected for different design configuration of bolted joints.

(Mohrbacher, Spöttl and Paegle, 2015) [9]Improved manufacturing technology is often needed when working with high strength steel. In this re- spect manufacturing technology has to adapt to the altered (and typically reduced) formability and weldability of modern high strength steel. However, this is a rather passive approach from a manufacturing point of view. An indeed much more powerful approach is to generate synergies between innovative manufacturing technology, design and material enabling additional weight savings and efficiency gains.

(Seyfried*et al.*, 2015) [8]focuses on an estimation of light weighting opportunities for the frame structure of

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commercial road vehicles. This estimation is based on simplified static load cases which play a predominant role for the dimensioning of a frame structure and therefore these simplifications are not putting the general validity of the conclusions into question. A comparison of different materials under this scenario shows that light metals do not show any weight reduction advantage in comparison to steel while a material-independent topology optimization has more weight reduction potential for the frame structure than a simple change of materials.

(Kirkemo, 2002) [2]flange joints designed for metal-to-metal face contact with self-seating and pressure activated seal rings have been used extensively in high-pressure applications in industrial piping, pressure vessels, pipelines, risers and associated equipment. These flange joints are generally much smaller and lighter, with smaller bolts, than equally rated standard gasketed flange joints, and are often called compact flange joints.

III. PROBLEM IDENTIFICATION

The below mentioned image shows the deterioration of the joint flange of a commercial vehicle because of the friction.

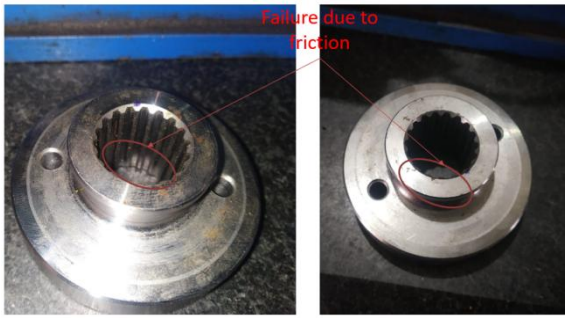

Figure 1 Failure due to friction

The below mentioned image shows a failed joint flange part attached to a commercial vehicle.

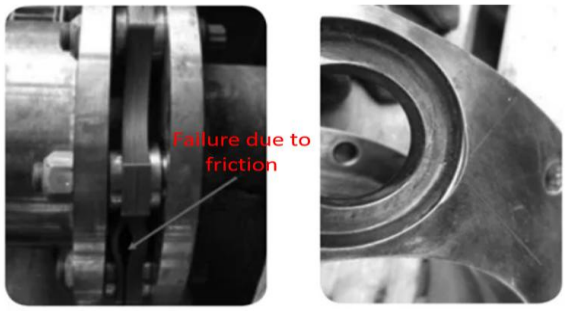

Figure 2 Failure due to friction with seal

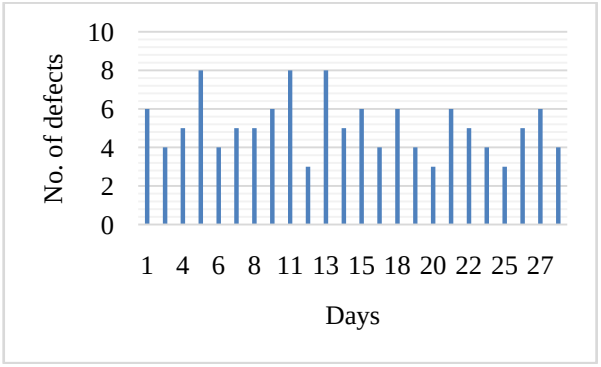

Figure 3 Number of defect per day

IV. DESIGN OF FLANGE

In this approach combine all your researched information in form of a journal or research paper. In this researcher can take the reference of already accomplished work as a starting building block of its paper.

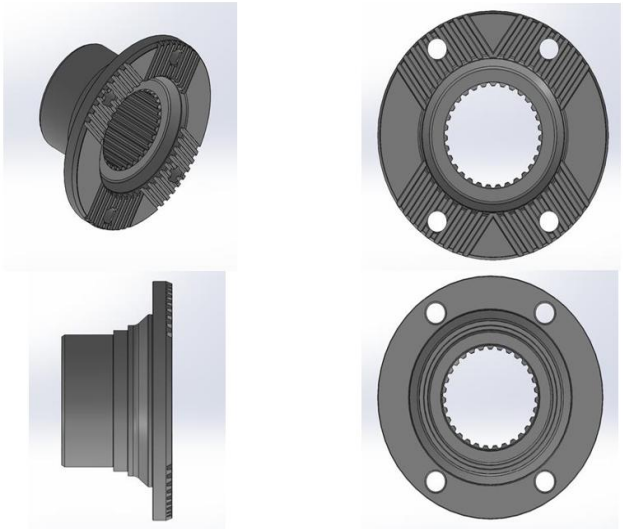

Figure 4 Design of flange in solidworks

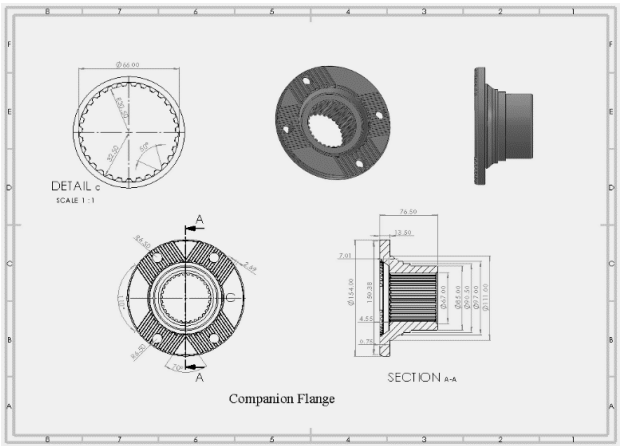

Figure 5 Dimension of flange in solidworks

V. MACHINING OPERATION

A. Raw Material

First of all for manufacturing companion flange, Raw material is selected as from different type of materials. Different tests were performed on raw material for better strength and better durability of companion flange. Different dimensions are considered and material grade report is an important aspect that was looked according to report given by the raw material supplier. And after that it was tested in lab for confirming the grade and other parameters to choose the final material for next process.

Table 1 Material collection

S. N.	CHARACTERSTIC		SPL CHARCL	PRODUCT/PROCESS SPECIFICATION	EVALUTION/ MEASUREMENT	SAMPLE	
	PRODUCT	PROCESS				SIZE	FREQ.

			AS S		TECHNI QUE		
1.	Surfa ce			Smooth & Rustles	Visual	5 Per Lot	
2.	All Dime nsion			As per forging drawing	Respectiv e gage	5 Per Lot	
3.	Mater ial grade			EN8D/BS9 70	Lab report	1 Per Lot	
4.	Mater ial grade			EN8D/BS9 70	Supplier report		

Table2process parameter table for Lath operation for front side

S. N.	CHARACTERSTIC		SPL CHAR CLASS	PRODUCT/PROCESS SPECIFICATION	EVALUTION / MEASUREMENT TECHNIQUE	SAMPLE	
	PRODUCT	PROCESS				SIZE	FREQ.
1.	Outer Diameter			$\emptyset 154^{+0.5}$	DVC(L, C-0.01)	2/Setup,2/Hr,2/End	
2.	Collar Thicknes s			$13.5^{+0.5}$	DVC(L, C-0.01)	2/Setup,2/Hr,2/End	
		Rpm		550-850	M/c setting	1 time	Per setup
		Feed		Manual	M/c setting	1 time	Per setup
		Tool Change/ Re-sharp		Wear out	Visual	1 time	Per setup
		Coolant Ph		8-10	Litmas paper	1 time	Per day
		Coolant Concentration		3-6%	Refractometer	1 time	Per day

B. Lath operation

A lathe is a machine that rotates the piece on the axis in order to perform various operations like cutting, facing, knurling, deformation and more. Metal spinning, thermal spraying, woodturning and metalworking are the common operations performed with a lathe machine. During this Operation Outer Diameter & Face clean cut will be occurred in the companion flange on Lath Machine, Bellow is the process parameter table for this operation. Where all parameters are defined with proper tolerance for more accurate and easy manufacturing process can be followed.

Figure 6Lathe operation

This Operation is also done on Lathe Machine for maintaining other side face clean cut & inner diameter of companion flange and the parameters are followed as per the below mentioned data in table 3.

Figure 7After lathe operation

C. Broaching

Broaching is a machining process that uses a toothed tool, called a broach, to remove material. There are two main types of broaching: linear and rotary. In linear broaching, which is the more common process, the broach is run linearly against a surface of the work piece to affect the cut. Linear broaches are used in a broaching machine, which is also sometimes shortened to broach. In rotary broaching, the broach is rotated and pressed into the work piece to cut an axisymmetric shape. A rotary broach is used in a lathe or screw machine. In both processes the cut is performed in one pass of the broach, which makes it very efficient.

This is the most important operation which is called as Broaching operation, This operation we have to conduct in a

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controlled manner, For this operation we have introduced a fixture on Broaching So that the issue of broaching shifting will not occurred again, Bellow are the process parameters for this operation.
The report was extracted from JJ precision and it showed the maximum deviation of less than 0.05mm. This deviation is under acceptable condition.

Before improvement		**After improvement**	
No. of Flange produced per day	No. of Flange defective	No. of Flange produced per day	No. of Flange defective
200	83	200	19

Productivity = output/input
Productivity before improvement = 127/200 = 63.5%
Productivity after improvement = 181/200 = 90.5%

VI. CONCLUSION

All the procedures of manufacturing have been successfully operated and the design proposed with the help of this study can be manufactured and successfully used in commercial vehicles on the results provided by this study. With the help of the CMM machine, the deviation in the proposed design and actual products was evaluated. The maximum deviation obtained was less than 0.05mm.

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