© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 12 Issue: 01 | January - March 2021
Paper is available at http://www.jrps.in | Email : info@jrps.in

A Review on Design for Manufacturing of Joint Flange of Commercial Vehicle

Harsh Kumar Sharma[1], Vidosh Mahate[2], Anand Bisen[3]

[1] M. tech Scholar, Department of Mechanical Engineering, SIRTE, Bhopal
[*2]Professor, Department of Mechanical Engineering, SIRTE, Bhopal
[3]Lecturer, Department of mechanical engineering, Kalaniketan polytechnic college jabalpur

Abstract- In high-pressure applications such as pressure vessels, risers, piping in industries and associated tools, flange joints are designed for self-seating with metal-to-metal face contact and for pressure activated seal rings which have been greatly used. The primary use of flanges is when dismantling joints as well as connections are required. Within the piping system, valves, pipe fittings and other integrals are included in flange joints. The behavior of bolted flange as well as its analysis is reviewed in this paper. In comparison with the metallic flanges, this present study focuses on the techniques which are available for the flanges manufacturing with respect to the possible challenges and issues.

Keywords- Flange Joint, Commercial Vehicle, Flange Design, Manufacturing Process, FMEA

I. INTRODUCTION

An automotive drive shaft transmits power from the engine to the differential gear of a rear wheel drive vehicle. For the enhancement of fundamental bending natural frequency, in 2 parts the drive shaft is manufactured; the reason behind this is that bending natural frequency is directly proportional with the square root of specific module which decreases with the fuel efficiency and increases with the total weight of an automotive vehicle as well as inversely proportional with the square of beam length. Stainless steel is considered in this study due to its higher strength and also a single piece drive shaft is also preferred here. The carriers of torque as well as the subject to torsion are the drive shafts and also the shear stress which are similar with the difference between the load as well as the input torque. Therefore, they must be powerful enough so that they can bear the stress. As assemblies or as the individual components, the companion flanges are supplied with the universal drive shafts. For the proper torque transfer, it allows connection of the flange yoke with the other type of connections.

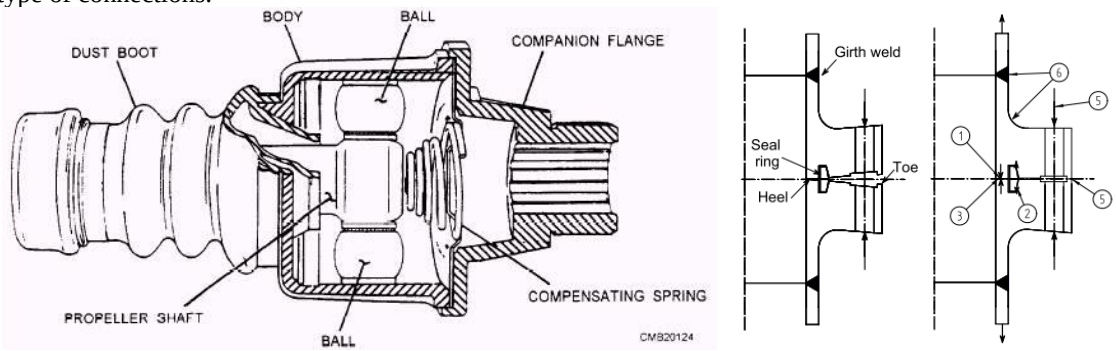

Figure 1 Basic component of Flange Joint

A. Types of Flanges

Different type of flanges that are used in piping based on pipe connection. There are many ways to classify Flanges. On the basis of pipe connections, different types of flanges are used in piping. There are several ways through which the Flanges can be classified.

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 12 Issue: 01 | January - March 2021
Paper is available at http://www.jrps.in | Email : info@jrps.in

Figure 2 Different type of Flange Joint

B. Failure Modes and Effects Analysis (FMEA

For the evaluation of the process, a systematic and proactive method called Failure Modes and Effects Analysis (FMEA) is used for identifying the place and reason behind its failure and it is also used for understanding the impact through different failures. It is used for identifying the process's parts which are major for the need of change.

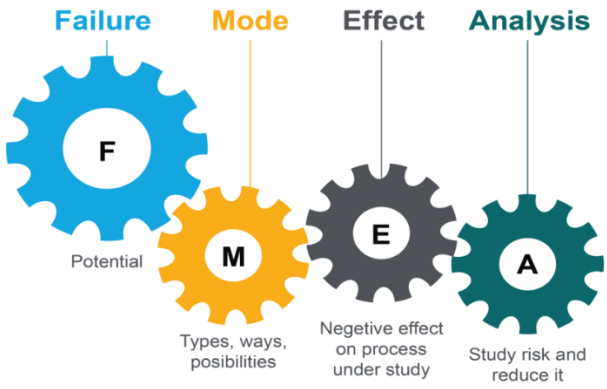

Figure 3 Process of FMEA

II. Literature Review

The literature study has been carried out on Design for Manufacturing of Joint Flange of Commercial Vehicle. The findings of various scholars in the field of Design for Manufacturing of Joint Flange have been presented below:

Dewangan et al. have analyzed that Companion flange is used as assembly part with universal drive shafts in vehicle transmission system. He also observed that 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 center position.

Hu et al. have evaluated from the study that at the V-notch corner, for the estimation of shear stress distribution, a simple method "Singularity Length Method" (SLM) is used with the key parameter "as" singularity length. 135 weld toe notches are used for the tube-flange welded joints (TFWJs); through different geometries, the singularity length 'as' is to be determined as well as it is summarized through into the concise formulas. On the basis of SLM, the mode III notch stress intensity factor (NSIF K3) is used for the quick calculation without any FEA process.

Raj et al. studied that in knuckle joints, overflowing and deluged composition are published as well as their importance in automobile industries. In present times, through better quality and productivity to achieve manufacturing excellence is the objective of various

industries. Through high productivity and by controlling the cost, every-governance is trying for the process of customer retention. With the help of some investigations on the dimensional accuracy, a significant as well as voluminous research article is presented by the author in which it includes degree of doubt, reduction in cycle time as well as proper placement of the knuckle part.

Kondaiah Bommisetty et al. According to kondaiah Bommisetty , different types of bolted flange joints are connected through the structures in aerospace. Stiffness, sealing to avoid leakages and joint strength are sum of the parameters which are considered through the basic functionality of the bolted joint. With the help of analysis, testing and augments, the capability of the joints is determined. In the bolted joint design, the fundamental requirement is the exact evaluation of bolt force in a bolted joint under the external loads. For the various connections of bearing housings, casings and in aero-engine for the rotor of gas turbine, different types of bolted joints are used such as stepped flange, conventional back-to-back flange and triple stack flange. For the different design configurations, bolted joints show difference in behavior as well as they are complex in design.

Mohrbacher et al. analyzed that when one is working with the high strength steel, enhanced manufacturing technology is required. For the altered weld ability and formality, manufacturing technology has been adopted for the modern high strength steel. Therefore, as per the manufacturer's point of view, it is considered as the passive approach. For enabling the efficiency gains and weight savings, a much more strong approach is needed for the generation of synergies in between the material, design and innovative manufacturing methods.

Seyfried et al. The study conducted by Seyfried focuses on the light weight opportunities for making the frame structure of commercial road vehicles. On simplified static loads, these estimations are based as for the dimensioning of the frame structure; predominant role is played by them. However, through these simplifications, no general validity of the conclusion is put into the questions. Under this scenario, a comparison of different materials is shown in the study that no weight reduction advantage is provided through light metals as compared to the steel. In comparison with the simple change in material, more weight reduction potential is observed in a material-independent topology optimization for the frame structure.

Kirkemo et al. According to the kirkemo, for high pressure applications such as pressure vessels, risers, pipelines and associated tools, the flange joints are extensively used for metal-to-metal face contact with pressure activated seal rings and self-seating. These flange joints are normally much lighter as well as smaller than similarly rated regular gasketed flange joints, with smaller bolts, and are sometimes they are referred as the compact flange joints.

Brunneke and Losche focuses on the study that one piece retaining body having expansion kept away to get simplification for atleast two components, and it's been simplified using fibers towards the main load direction, having one axle body with flange joint will avoid the axial load with the help of one base region, act as one installable component, along with this installation effort is also minimized. In the multi axle body design, additional channel is provided by the author in his paper to make the joint upward with A- shaped arm.

Mohrbacher et al. have reviews the paper related to concept of manufacturing technology is commonly used for the high robustness steel. The usage of laser based welding method shows immense ability and the usage of hot sampling and roll forming opens new possibilities in final flange components. The usage of fined grained steel as homogenous material for the fine welding procedures having low carbon content and this approach given by the author provides high productivity and low cost input. Weight can also be reduced as single component with the help of high strength steel.

Maret has reviews the paper about the Vehicle Frame Joint, an invention to improve the side rail and the commercial vehicle passages, with the C shaped crossing system gives robustness and compactness to the structure with desirable vehicle frame, as it is the enlarged view with respect to upper cross piece and gusset (first and second). When its I – shaped or open C shaped cross section, the passage system for the commercial vehicles gets standstill with the help of vertical passage system then the horizontal based passage system.

Numerical Simulation techniques are advantageous for the maximum value assimilation for the thickness of body flange and cover flange that is between 48 mm to 90 mm. This review presents the usage of technique known as FEM 'Finite Element Method', with the help of this technique 3 D Model of the analytical design by avoiding stress allowable and designed stress will lead to decrease in its dimension with more robustness**. [P. M. Desai et al.]**

work an attempt has been made for design optimization of composite drive shafts for power transmission applications. The one-piece composite drive shaft is designed to replace conventional steel drive shaft of an automobile using E-glass/epoxy and high modulus carbon/epoxy composites. A solution technique using ansys for design optimization of composites drive shafts is presented here. The purpose of using ansys to minimize the weight of shaft that is subjected to the constrains such as torque transmission. The weight savings of the E-glass/epoxy and corbon/epoxy shaft were 15%and 72%of the steel shaft respectively[**Sivakandhan et al.]** .

Mechatronic shifting simulation of automated trans- missions in commercial vehicles is used for optimi- zation and development in today's truck engineering departments at Daimler. Within the ITEA2 project Modelisar in cooperation with ITI GmbH and SIM- PACK AG this application served as a usecase for proof of concept of the newly developed Functional Mock-Up interfaces (FMI). Utilizing these standard- ized interfaces models from different tools are cou- pled to build up the overall system for the mecha- tronic shifting simulation. The coupling via FMI for Model Exchange was achieved for control modules from MATLAB/Simulink into the SimulationX powertrain model and secondly from the 1D- multiphysics powertrain in SimulationX into multi- body vehicle in SIMPACK [**Abel et al.**] .

The weight reduction of the drive shaft can have a certain role in the general weight reduction of the vehicle and is a highly desirable goal, if it can be achieved without increase in cost and decrease in quality and reliability. It is possible to achieve design of composite drive shaft with less weight to increase the first natural frequency of the shaft and to decrease the bending stresses using various stacking sequences. By doing the same, maximize the torque transmission and torsional buckling capabilities are also maximized. [**Zulfadhli Bin and Zaki]**

III. CONCLUSION

In car and other commercial vehicles, reduction in weight is expected through the improvement in adhesion technology for combining different types of materials. From the research conducted by (Dewangan et al.), the wobbling problem is studied which occurs during the transmission testing and through instrumental measurements (vernier caliper, screw gauge) he rectified the problems by using New Fixture Method. (Hu *et al.*) used "Singularity Length method" for the estimation of shear stress distribution without any FEA process. (Raj, Dayalan and Shrivardhan) performed the study on knuckle joints in which he included the reduction in cycle time as well as the proper placement of knuckle parts. He also concluded that through high productivity and by controlling the cost, the process of customer retention can be obtained. Kondaiah Bommisetty and Mahendra Kenchegowda analyzed the problem of stiffness and leakages; to avoid such problems he performed tests and augments with the help of analysis so that the capability of the joints can be determined. For the different design configurations, bolted joints show difference in behavior as well as they are complex in design.

For these types of transport vehicles, different levels of stress and stress ratios are loaded onto the joints. The design methodologies are considered in this review paper for the design of seal ring, bolts and flanges as per the assembly guidelines. The design principles presented in the literature review section are sound and offer many fundamental advantages over the conventional type of joint, apart from reduced weight and size. It was also observed from the study that for enabling the efficiency gains and weight savings, a much stronger approach is needed for the generation of synergies in between the material, design and innovative manufacturing methods. However, design codes should address these types of joints in future.

REFERENCES

Abel, Andreas, et al. "Functional Mock-up Interface in Mechatronic Gearshift Simulation for Commercial Vehicles." *Proceedings of the 9th International MODELICA Conference, September 3-5, 2012, Munich, Germany*, vol. 76, 2012, pp. 775–80, doi:10.3384/ecp12076775.

Brunneke, Hans-Gerd, and Christian Losche. *MOTOR VEHICLE, PARTICULARLY COMMERCIAL VEHICLE, AND JOINT ARRANGEMENT (75)*. no. 12, 2014.

Dewangan, Ashish, and Sankalp Verma. "Modification of Manufacturing Process for Companion Flange Used in Commercial Vehicles and Its Analysis." *Journal of Emerging Technologies and Innovative Research (JETIR) Www.Jetir.Org*, vol. 7, no. 7, 2020, pp. 918–29.

Hu, Yaoyu, et al. "Notch Stress Analysis and Fatigue Strength Assessment of Tube-Flange Welded Joints under Torsion Loading." *Ocean Engineering*, vol. 186, no. May, Elsevier Ltd, 2019, p. 106074, doi:10.1016/j.oceaneng.2019.05.056.

Kirkemo, Finn. "Design of Compact Flange Joints." *American Society of Mechanical Engineers, Pressure Vessels and Piping Division (Publication) PVP*, vol. 433, no. January 2002, 2002, pp. 91–104, doi:10.1115/PVP2002-1087.

Kondaiah Bommisetty, and Mahendra Kenchegowda. "Studies on Behavior of Conventional Back-to-Back and Stepped Flange Bolted Joints." *International Journal of Engineering Research And*, vol. V5, no. 01, 2016, pp. 353–58, doi:10.17577/ijertv5is010333.

Maret, Ray H. *United States Patent (19)*. no. 19, 1975.

Mohrbacher, Hardy, et al. "Innovative Manufacturing Technology Enabling Light Weighting with Steel in Commercial Vehicles." *Advances in Manufacturing*, vol. 3, no. 1, 2015, pp. 3–18, doi:10.1007/s40436-015-0101-x.

P. M. Desai, et al. "DESIGN, ANALYSIS AND OPTIMISATION OF BODY FLANGE AND COVER FLANGE USING FINITE ELEMENT ANALYSIS." *Nternational Journal of Mechanical Engineering and Technology (IJMET), ISSN 0976 – 6340(Print), ISSN 0976 – 6359(Online) Volume 4, Issue 5, September - October (2013) © IAEME INTERNATIONAL JOURNAL OF MECHANICAL ENGINEERING AND TECHNOLOGY (IJMET)*, vol. 4, no. 5, 2015, pp. 7–18.

Raj, S. Yeshwant, et al. "Investigation of Knuckle Joint and Its Importance - A Literature Case Study." *2018 7th International Conference on Industrial Technology and Management, ICITM 2018*, vol. 2018-Janua, no. May, 2018, pp. 62–70, doi:10.1109/ICITM.2018.8333921.

Seyfried, Peter, et al. "Light Weighting Opportunities and Material Choice for Commercial Vehicle Frame Structures from a Design Point of View." *Advances in Manufacturing*, vol. 3, no. 1, 2015, pp. 19–26, doi:10.1007/s40436-015-0103-8.

Sivakandhan, C., and P. Suresh Prabhu. "Optimum Design and Analysis of the Drive Shaft in Composite Material." *Material Science Research India*, vol. 8, no. 1, 2011, pp. 125–30, doi:10.13005/msri/080118.

Zulfadhli Bin, Muhammad, and M. D. Zaki. "DESIGN AND ANALYSIS OF A COMPOSITE DRIVE SHAFT FOR AN AUTOMOBILE." *International Review of Applied Engineering Research*, vol. 4, no. 1, 2012, pp. 21–28, https://core.ac.uk/download/pdf/159181549.pdf.