Impact Factor:						
	ISRA (India)	= **6.317**	**SIS** (USA)	= **0.912**	**ICV** (Poland)	= **6.630**
	ISI (Dubai, UAE)	= **1.582**	**РИНЦ** (Russia)	= **3.939**	**PIF** (India)	= **1.940**
	GIF (Australia)	= **0.564**	**ESJI** (KZ)	= **8.771**	**IBI** (India)	= **4.260**
	JIF	= **1.500**	**SJIF** (Morocco)	= **7.184**	**OAJI** (USA)	= **0.350**

SOI: 1.1/TAS DOI: 10.15863/TAS

International Scientific Journal

Theoretical & Applied Science

p-ISSN: 2308-4944 (print) **e-ISSN:** 2409-0085 (online)

Year: 2024 **Issue:** 03 **Volume:** 131

Published: 18.03.2024 **http://T-Science.org**

Issue **Article**

Denis Chemezov
Vladimir Industrial College
MEng, Honorary Worker of the Education Field of the Russian Federation, Academician of International Academy of Theoretical and Applied Sciences, Lecturer, Russian Federation
https://orcid.org/0000-0002-2747-552X
vic-science@yandex.ru

Andrey Aleksandrov
Vladimir Industrial College
Foreman of vocational training, Russian Federation

Natalya Zezina
Vladimir Industrial College
Foreman of vocational training, Russian Federation

Veronika Khlebnikova
Vladimir Industrial College
Student, Russian Federation

Aleksandr Zhirov
Vladimir Industrial College
Student, Russian Federation

Rodion Yurenko
Vladimir Industrial College
Student, Russian Federation

Abubakr Khasanov
Vladimir Industrial College
Student, Russian Federation

Nikita Rybin
Vladimir Industrial College
Student, Russian Federation

Vitaliy Peskov
Vladimir Industrial College
Student, Russian Federation

Vladislav Zhgarov
Vladimir Industrial College
Student, Russian Federation

Ilyas Evstigneev
Vladimir Industrial College
Student, Russian Federation

Impact Factor:	ISRA (India) = 6.317	SIS (USA) = 0.912	ICV (Poland) = 6.630
	ISI (Dubai, UAE) = 1.582	РИНЦ (Russia) = 3.939	PIF (India) = 1.940
	GIF (Australia) = 0.564	ESJI (KZ) = 8.771	IBI (India) = 4.260
	JIF = 1.500	SJIF (Morocco) = 7.184	OAJI (USA) = 0.350

THE EFFECT OF EXTERNAL LOAD ON THE VALUES OF CONTACT AND FRICTION FORCES IN A CYLINDRICAL ROLLER BEARING

Abstract: *The results of computer calculation of the operation of a cylindrical roller bearing were presented in the article. The changes in the contact and friction forces of roller elements on the surface of the inner and outer rings in the cylindrical roller bearing under the influence of various external loads were analyzed.*

Key words: *cylindrical roller bearing, load, contact force, friction force.*

Language: *English*

Citation: Chemezov, D., et al. (2024). The effect of external load on the values of contact and friction forces in a cylindrical roller bearing. *ISJ Theoretical & Applied Science, 03 (131),* 88-90.

Soi: http://s-o-i.org/1.1/TAS-03-131-14 ***Doi***: https://dx.doi.org/10.15863/TAS.2024.03.131.14

Scopus ASCC: *2210.*

Introduction

Currently, the industry represents a large range of bearings. A bearing is an assembly that is part of a support or abutment and supports a shaft, axle, or other movable construction with a given stiffness.

The cylindrical roller bearing is manufactured with high precision from special heat-treated steels, in accordance with ISO 12297-1:2021 [1]. A feature of the cylindrical roller bearing is the installation of roller elements in the separator between the inner and outer rings to ensure rotation with the least resistance [2]. Thus, the bearing elements perceive dynamic and static loads from the moving assembly, which can lead to vibration of the bearing and increased wear of the roller elements. The analysis of these effects has been performed in a number of scientific papers [3-10].

In this work, by simulating the dynamics of the cylindrical roller bearing system, the dependences of changes in the contact and friction forces of roller elements on the value of the external load action were determined. The calculation results will allow us to estimate the changes in the bearing parameters under different loading conditions.

Materials and methods

The dynamics of operation of the cylindrical roller bearing with an outside diameter of 100 mm and a bore diameter of 56 mm were simulated. Cylindrical roller elements with a diameter of 12 mm were installed between the inner and outer rings having outside and inside diameters of 32.875 mm and 45.125 mm, respectively. The bearing clearance was assumed to be 0.125 mm. The inner ring of the bearing is connected to a shaft that rotates at a constant speed of 5000 rpm. The outer ring is connected to a fixed foundation. An external load of 100, 500, 1000 and 2000 N was applied to the inner ring of the bearing. The friction coefficient was assumed to be 0.1. The loading time of the cylindrical roller bearing was assumed to be 0.06 s.

Results and discussion

The calculation results were processed and presented graphically in the Fig. 1. Changes in the values of the contact and friction forces of the roller elements on the surface of the inner and outer rings of the cylindrical roller bearing over time were subject to consideration.

It is noted that with an increase in the value of the applied external load, the value of the contact force of the roller elements on the surface of the inner and outer rings of the cylindrical roller bearing decreases. For example, when an external load of 100 N is applied, the peak value of the contact force can reach 115 N. And when an external load of 2000 N is applied, the peak value of the contact force is about half the value of the applied external load. The friction force that occurs during contact is approximately 5-10% of the value of the contact force.

With an increase in the external load, the cyclic action of contact and friction forces in the cylindrical roller bearing is observed. If, when exposed to an external load of 100 N, there is only one cycle of contact and friction forces and it is longer in time, then when exposed to external loads of 500 and 1000 N, there are two cycles of contact and friction forces, and when exposed to an external load of 2000 N, three cycles occur. At the same time, the cycle duration decreases with increasing load. The contact and friction forces are zero between cycles. The nature of the change in contact and friction forces is the same under the action of external loads of 1000 and 2000 N.

Conclusion

Thus, it is safe to say that the maximum value of the contact force of the roller elements on the surface of the inner and outer rings of the bearing occurs at the beginning of the cycle. The values of the contact force at low values of the external load is greater than at significant external loads. At the same time, the more external load is applied, the more cycles of action of the contact and friction forces occur in the bearing. The friction force varies in a small range simultaneously with the contact force.

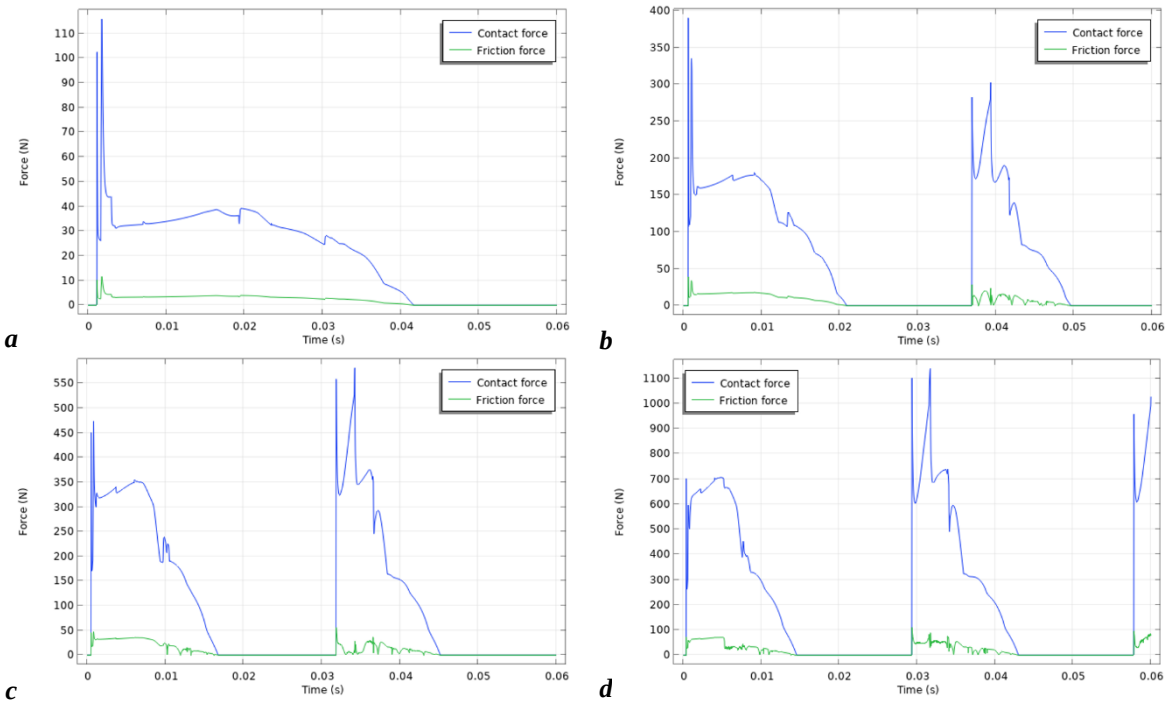

Figure 1. Changes in the contact and friction forces of roller elements on the surface of the inner and outer rings in the cylindrical roller bearing when exposed to an external load of 100 N (*a*), 500 N (*b*), 1000 N (*c*) and 2000 N (*d*).

References:

1. (2021). *ISO 12297-1:2021. Rolling bearings. Cylindrical rollers. Part 1: Boundary dimensions, geometrical product specifications (GPS) and tolerance values for steel rollers.*
2. Ijuin, S., Yamamoto, & Takashi. (2003). *Cylindrical Roller Bearing*, NSK LTD, Tokyo, Japan.
3. Harris, T. A., & Kotzalas, M. N. (2010). *Rolling Bearing Analysis. Essential Concepts of Bearing Technology*, Machinery Industry Press, Beijing, China, 144-148.
4. Li, L., Xue, Y., Li, J., & Wang, W. (2022). Control Method of the Kinematic Accuracy of Cylindrical Roller Bearing. *J. Robot. Auto. Res*., 3(3), 258-269.
5. Hong, S. W., & Tong, V. C. (2016). Rolling-element bearing modeling: a review. *International Journal of Precision Engineering and Manufacturing*, 17 (12), 1729-1749.
6. Prisacaru, G., Bercea, I., Mitu, N., & Cretu, S. (1995). Load distribution in a cylindrical roller bearing in high speed and combined load conditions. *European Journal of Mechanical and Environmental Engineering*, vol. 40, 19-25.
7. Qu, T., et al. (2022). Study on Contact Force and Vibration Characteristics of Composite Cylindrical Roller Bearing. *International Journal of Rotating Machinery*, vol. 2022, 1-10.
8. Ramu, B., & Murthy, V. V. R. (2013). Contact Analysis of Cylindrical Roller Bearing Using Different Roller Profiles. *IJRMET*, Vol. 3, Issue 1, 29-33.
9. Chen, G., Mao, F., & Wang, B. (2012). Efects of of-sized cylindrical rollers on the static load distribution in a cylinder roller bearing. Proceedings of the Institution of Mechanical Engineers - Part J: *Journal of Engineering Tribology*, vol. 226, no. 8, 687-696.
10. Tong, V. C., & Hong, S. W. (2017). Modeling and analysis of double-row cylindrical roller bearings. *J. Mech. Sci. Technol*., 31, 3379-3388.