ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE)
Vol. 1, Issue 4, November 2015

Calibration for Non-Contact Loading Potential as Function Gap and Voltage-Current for Static and Operating Shaft

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Abstract— **In this study, an experiment carried out on a cantilever static and operating shaft. The different types of load on static and operating shaft such as concentered point load, uniformly distributed load and uniformly varying loads that causes excessive noise, stress formation and friction generation between shaft and bearing that leads to complete or partial failure of a machine parts. The calibration of load capacity of shaft is such a one parameter and it is very difficult to calibration of load capacity of static and operating shaft.**

In this work an effort is made to calibration of load capacity of static and operating shaft by new technique, this work is about experimentally to calibration of load capacity of static and operating shaft by new technique is non-contact loading potential as function gap and voltage current with the help of electromagnet.

***Index Terms*— Eddy current proximity probe, Electromagnet, NV Gate software, S-Type load cell.**

1. INTRODUCTION

An electric motor having capacity of 1hp is used to rotate the shaft with certain speed and an electromagnet having 20 kg capacity is used to give impulse on a static or operating shaft and then load capacity of static and operating shaft is measured using S-Type load cell.

Load cell having capacity of 20 Kg is used to convert the load acting on it into analog electric signal. This analog electric signal is converted into digital signal which is displayed on load indicator, from load indicator to measure load capacity of shaft. To conducted experiment with varied gap between shaft and electromagnet then corresponding readings read in load indicator.

2. LITERATURE REVIEW

Zhunag li, Surendra N. Ganeriwal and Mark h. Richardson has demonstrated the effects of rotating machinery shaft misalignment on its dynamic behavior which is characterized in the form of an operational deflection shape. In this approach, an operational deflection shape derived from multiple accelerometer signals acquired at various points on the machine is used to diagnose shaft misalignment. Tests are performed on a machinery fault simulator under various operating conditions. Operating data is simultaneously acquired using a multi-channel data acquisition system.

And William W. Clark, Joo-Hyung Kim, Roy D. Marangoni has used technique for measuring and actively controlling dynamic bearing loads in rotating machinery subject to periodic excitations. Bearing loads are estimated using the Deflection-Coefficient method, a technique which does not rely on a full system model, and which applies commonly-used shaft-deflection measurement equipment to obtain estimates of bearing loads.

3. EXPERIMENTAL SETUP

Fig. 1) Assembly showing electromagnet and S-type load cell.

Fig. 2) Experimental setup front view

Fig. 3) Experimental setup top view

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When the distance between shaft and electromagnet decreases, load capacity of shaft increases and vice versa. A 230volt AC power is supplied to electromagnet by using 24volt DC converter and three position switch (i.e., OFF-ON-OFF switch).

When the OFF-ON-OFF switch is in ON condition, electromagnet creates impulse on the shaft and then the load cell displays the load capacity of shaft on the load indicator. The same experiment is repeated by changing the distance (gap) between electromagnet and shaft.

4. EXPERIMENTAL RESULTS

4.1) Calibration for non-contact loading potential as function gap and voltage current for static shaft

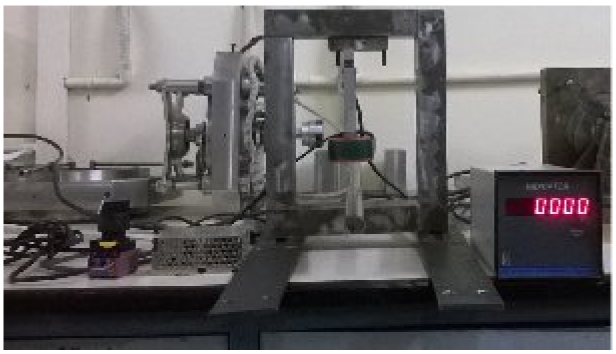


Fig. 4) Gap between electromagnet and shaft is 14.4 mm with zero impulse on shaft at static condition.

Fig. 5) Gap between electromagnet and shaft is 14.44 mm with an impulse on shaft at static condition.

1. 24volt DC and 230volt AC power supply.
2. Load capacity is 8 grams.
3. Scaling factor for load indicator is 2.73
4. Total load in Newton = 8*2.73*0.001*9.81 = **0.2143 N.**

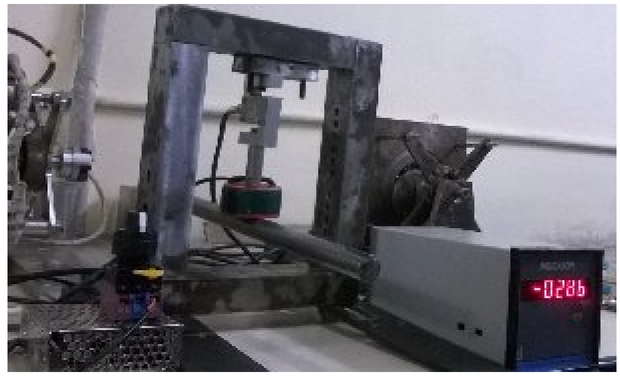
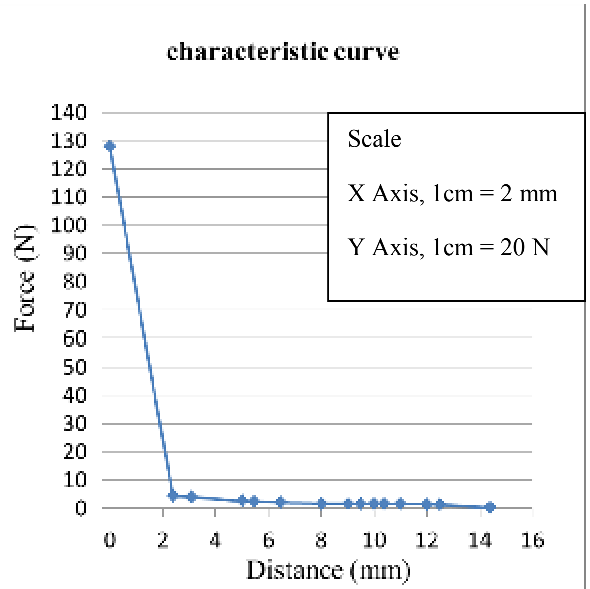


Fig. 6) Gap between the electromagnet and shaft is **ZERO** with an impulse on shaft at static condition.

1. 24volt DC and 230volt AC power supply.
2. Load capacity is **286** grams.
3. Scaling factor for load indicator is 2.73
4. Total load in Newton = 286*2.73*0.001*9.81 = **127.53N.**



Graph 1) Characteristic curves (force v/s distance) for shaft at static condition

From the graph 1, one can observe that, the maximum gap provided between electromagnet and shaft is 14.4 mm with a load capacity of nearly 0.22 N. Also for zero gaps between electromagnet and shaft, the load is nearly 128 N at static condition. This is maximum capacity of electromagnet used. The load capacity of shaft increases with decreases of distance between shaft and electromagnet and vice versa.

4.2) Calibration for non-contact loading potential as function gap and voltage current for operating shaft

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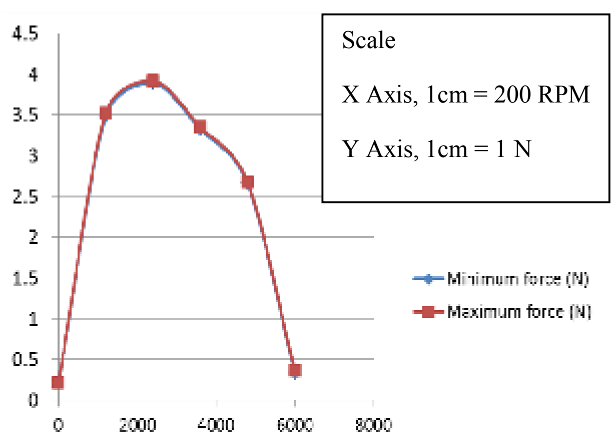
Fig. 7) Shaft is running at 461rpm and load capacity is 279 grams with impulse

Sl. NO	Speed of shaft (RPM)	Minimum force (N)	Maximum force (N)
1	0	0.220	0.220
2	1200	3.480	3.519
3	2400	3.891	3.921
4	3600	3.325	3.353
5	4800	2.653	2.678
6	6000	0.345	0.368

Table 1) Distance between electromagnet and operating shaft is **14.44** mm.

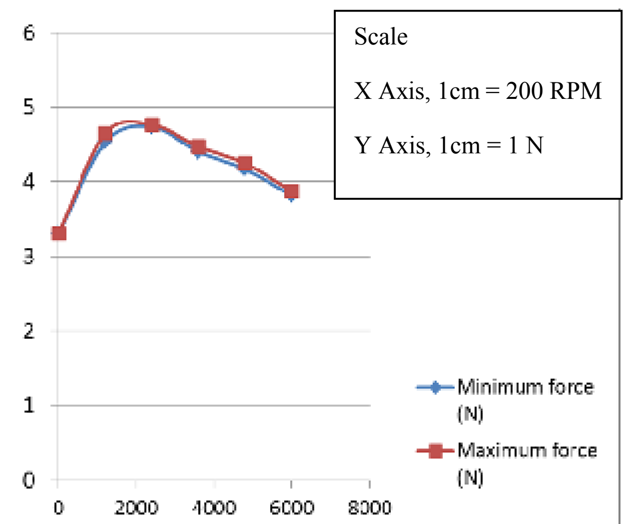


Graph 2) Characteristic curve (force versus speed) for rotating shaft with constant gap of 14.44 mm

From graph 2, the load capacity of shaft increases with increase of shaft speed up to 2400 rpm, after that load capacity of shaft suddenly decreases with increase in shaft speed.

Sl.NO	Speed of shaft (RPM)	Min. force (N)	Max. force (N)
1	0	3.301	3.301
2	1200	4.532	4.650
3	2400	4.738	4.768
4	3600	4.405	4.473
5	4800	4.169	4.248
6	6000	3.816	3.875

Table 2) Distance between electromagnet and rotating shaft is **4.92** mm.



Graph 3) Characteristic curves (force versus speed) for rotating shaft with a constant gap of 4.92 mm.

From graph 3, the load capacity of shaft increases with increase of shaft speed up to 2400 rpm, after that load capacity of shaft slightly decreases with increase in shaft speed.

5. CONCLUSIONS

1) For static shaft, the load capacity of shaft increases with decreases of distance between shaft and electromagnet and vice-versa.
2) For operating shaft,

a) The load capacity of shaft increases with increase of shaft speed up to 2400 rpm, after that load capacity of shaft suddenly decreases with increase in shaft speed when constant gap between shaft and electromagnet is 14.44 mm.

b) The load capacity of shaft increases with increase of shaft speed up to 2400 rpm, after that load capacity of shaft slightly decreases with increase in shaft speed when constant gap between shaft and electromagnet is 4.92 mm.

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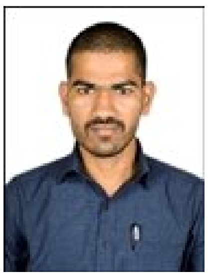

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