

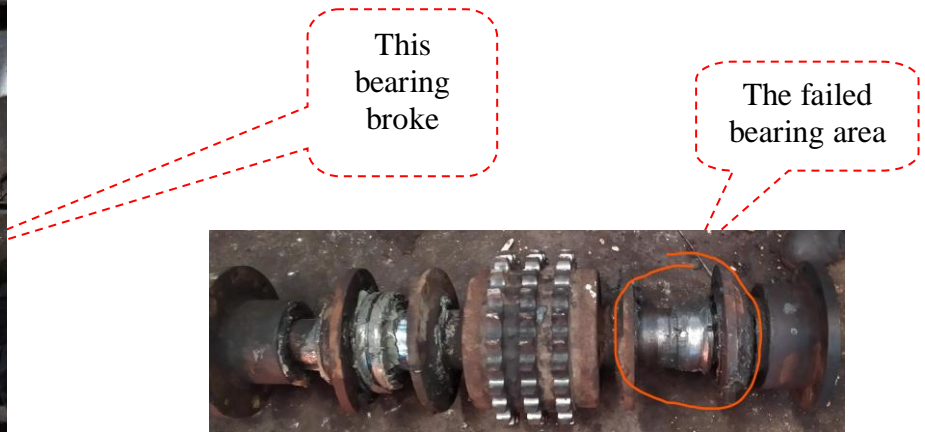
## Failure Analysis of DIP SPM-01-Mould Roller Drive Bearing

### **Abstract:**

The SPM-01 mould roller drive bearing failed during operation. On opening the bearing after taking out the mould it was found that the bearing was totally damaged. First indication did not support lack of lubrication though the bearing operates in a submerged condition. On salvaging the broken parts of the bearings the bearing lock washer was not traceable though the bearing was mounted on the shaft and locked with a lock nut. Further investigation showed that when the shaft was refurbished at the plant's machine shop the machinist did not make the locking key slot though it was provided in the original drawing. The root cause of the failure was the lack of knowledge of the person assembling the bearing and the flaw in inspection of machined items from the plant's machine shop.



Picture 1: Location of the broken bearing



Picture 2: Drive shaft taken out after bearing failure.


### **2: Observation:**


1. The failure occurred on 21<sup>st</sup> February 2021 in B shift while the machine was in operation.
2. The drive shaft was changed few weeks earlier.
3. The shaft was refurbished in the plant's machine shop.
4. During dismantling of the bearing no lock washer was found for bearing lock.
5. Adequate grease was found in the bearing.


The failed shaft and the bearing were collected and cleaned for failure analysis.


### **3: Failure Analysis of the Damaged Parts**

#### (a) Bearing

Inner Race	Observation	Analysis
	The inner race had cracked but there was no sign of severe abrasion that normally observed due to lack of lubrication	<u>This indicates that the inner race was subjected to great impact during operation.</u>

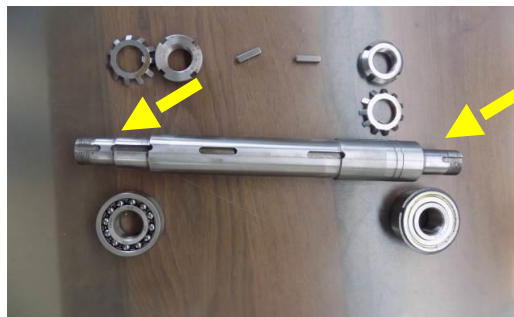
Inner Race	Observation	Analysis
	The bore of the inner race had no deterioration or abrasion except for the crack.	<u>This indicates that the bearing mounting was proper but there was an impact force on the bearing.</u>

Rolling Element	Observation	Analysis
	There was indication of impact on the rolling element but no sign of lack of lubrication	<u>This indicates that the rolling elements were subjected to impact load.</u>

Lock Nut	Observation	Analysis
	Deep rubbing mark of the bearing inner race on the screw.	<u>This was an indication the bearing was rubbing on the lock nut.</u>

#### 4:Sequence of Failure:

1. Analysis (red letters) indicates that the failure of the bearing was not due to lack of lubrication but due to an impact on the rolling elements and the inner race.
2. The deep rubbing marks on the lock washer indicates that the bearing inner race was constantly rubbing on the lock nut..
3. The above points raised a doubt as the bearing inner race can never rub on the lock nut as there supposed to be a lock washer in between them.
4. As the lock washer could be traced after bearing dismantling ,not even any broken pieces , it was evident that the lock washer was not fitted during assembly.
5. Checking the damage shaft no key slot was also found that locks the washer with the shaft . An example of key slot is shown (Picture :3 )



Picture: 3 Shaft with a key slot for lock washer locking

#### 5:Root Cause of Failure:

1: The shaft on which the bearing was mounted was in use for a long time and due to wear its threads were refurbished in the departmental machine shop. After machining the key slot was not made and not detected during assembly..

2: During assembly the fitter did not had the knowledge that the lock nut cannot be fitted without the lock washer so when he found no key slot in the shaft he discarded the washer and simple screwed in the lock nut.

3: During operation the lock nut loosened out and the bearing moved over the shaft and rubbed against the nut

4. The looseness of the bearing on the shaft caused an overall impact on it and lead to the untimely failure.

#### 6:Recommendation:

1. After any machining in department machine shop there should be a procedure of inspection with the drawing and approval. This the departmental head has to initiate and bring under ISO documentation.
2. Fitters have to be trained on the function of lock washer and lock nut preferably with an One Point Lesson.(OPL)
3. A One Point Lesson has been made and enclosed with this report.