Construction and Maintenance Management Inc.

BY:	**Rolando Ionta**	**DATE:**	**15-Mar-00**
CHK'D:		**DATE:**	
Project No.	**YY-XXX**		
Description:	**Client Name Here**		
Blast Furnace- Bull Wheel Bearing Failure Review			
Report e-mailed to "Mr. XXXX" on mm/dd/yr.			

Tape No. 2 3/10/00; 9:40 AM

Tape No. 2 3/14/00; 10:03 AM

Purpose of Inspection:

"Mr. XXXX" of "Client Name" requested that CMM review the recent bearing failure on one of the Bull Wheel bearings. "Mr. XXXX" advised to refer to "Mr. Y" and "Mr. Z" for the failed bearing and any other additional information.

Data Provided by Client:

The following data/information was provided by "Mr. XXXX" during various conversations.

1- A bucket with the failed bearing was given to Rolando Ionta on 2/15/00.
2- The failed bearing was from the Top Southwest Bull Wheel Assembly.
3- This bearing does not typical fail for this type of application.
4- This particular bearing was replaced during routine maintenance in December of 1999 and lasted only 6 weeks.
5- The bearing housing was severely damaged, but not available for visual inspection.
6- The Bull Wheel Axle was also severely damaged.
7- The failed Southwest Bull Wheel Assembly was presently located behind station "XXX".

Bearing Inspection Procedure:

The inspection for this project consisted of a visual inspection of the failed Bull Wheel Assembly behind Station "XXX" on March 10, 2000 and an "IN OFFICE" visual inspection of the failed bearing.
The field inspection was performed by Rolando Ionta and Bogdan Mazurczyk of CMM.
The "IN OFFICE" visual inspection was performed on March 14, 2000 by Rolando Ionta assisted by Bogdan Mazurczyk and Zangwill Sher.
Both visual inspections were videoed taped.

Client Reference Drawings:

1-	Drawing No.	XXXXX-1	"Blast Furnace Arrangement"
2-	Drawing No.	XXXXX-2	"Blast Furnace Details"
3-	Drawing No.	XXXXX-3	"Blast Furnace Details"
4-	Drawing No.	XXXXX-4	"Blast Furnace Details"

Inspection Observations and Findings:

The following video capture photographs and comments clearly depict the findings of the inspection. The entire field video is available for review if required/preferred.

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Tape No. 2 3/14/00; 10:03 AM

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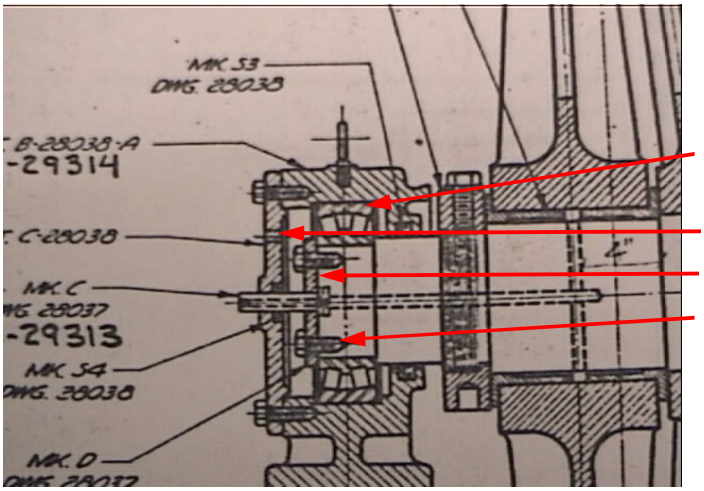

PHOTO No. 1

This is a portion of drawing "XXXXX" depicting the bearing assembly.
No. 22230 double row spherical roller bearing.
Grease hole for bearing.
Bearing Retainer.
4 Cap Screws for bearing retainer.

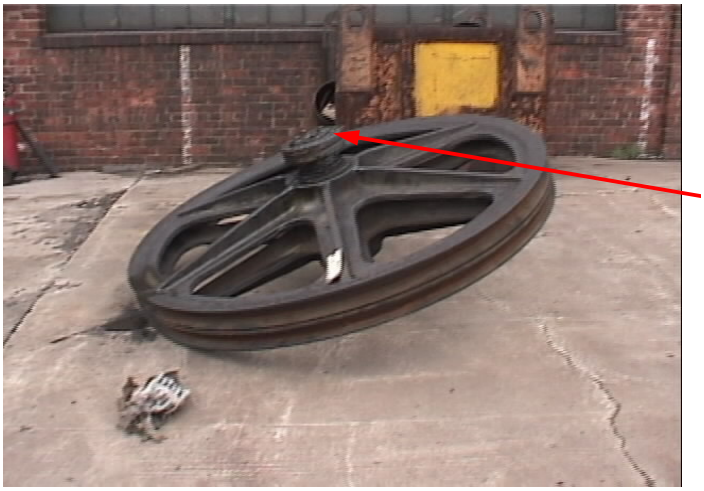

PHOTO No. 2

This is a photo of the failed Southwest Bull Wheel located behind Station "XXX".

Notice that one bearing is still in place.

The shaft end of the failed bearing is resting on the ground and not visible in this photo.

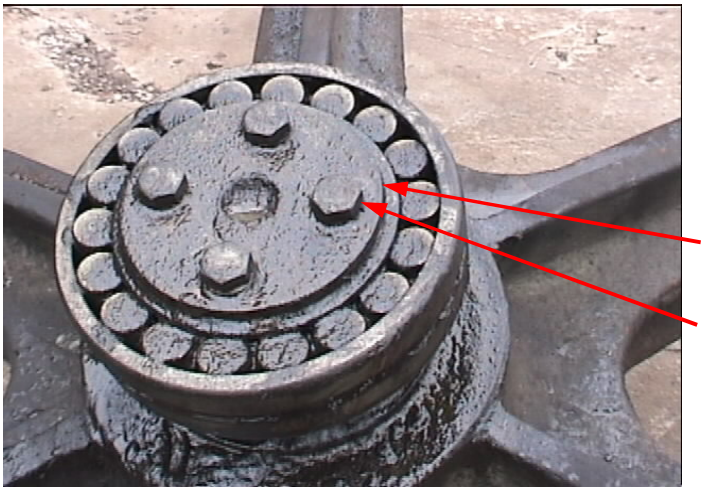

PHOTO No. 3

Closer view of the bearing shown in photo 2 above. This is a double row spherical roller bearing.

Notice the Bearing Retainer.

Notice the Four (4) bearing retainer Hex Head Cap Screws.

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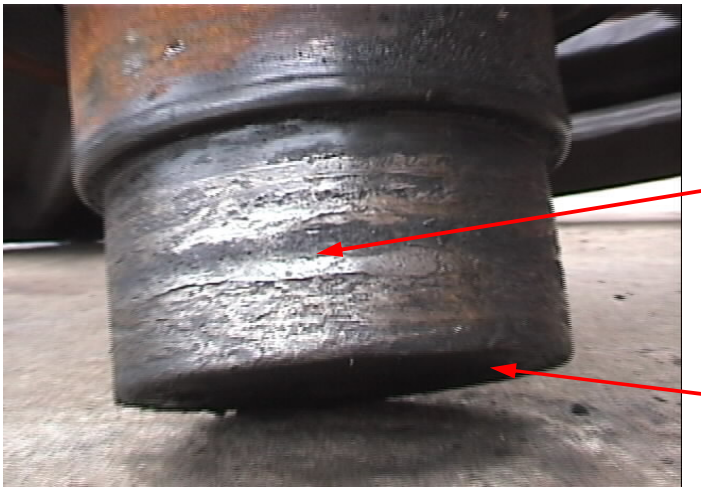

PHOTO No. 4

This photo depicts the shaft end of the failed bearing.

Notice the severe GALLING and discoloration.
See photo 5 for a closer view.

Although not visible in this photo, there are 4 sheared retainer cap screws in the shaft.

PHOTO No. 5

This is a close-up view of the shaft shown in photo 4 above.

Notice the severe GALLING, which is a physical displacement of metal due the inner race of the bearing spinning on the shaft.
Notice the discoloration of the shaft which depicts overheating.

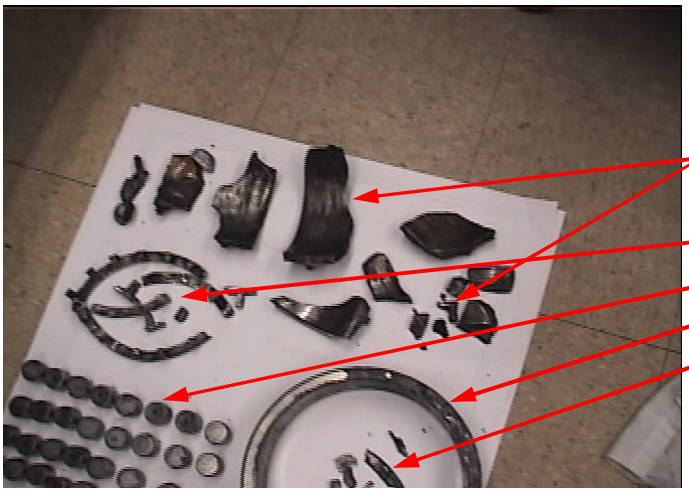

PHOTO No. 6

This photo depicts the failed bearing components laid out for visual examination.
Inner bearing race fragments. Range from 1/2" to 6" long fragments.
Roller cage fragments.
Spherical Rollers (34 rollers).
Outer bearing race.
Outer bearing race fragments. Range from 3/4" to 2 1/4" long fragments.
Not shown in photo, 3 retainer cap screws.

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PHOTO No. 7

This photo depicts the three (3) retainer hex head cap screws of the failed bearing.
Not shown in photo 6.

All three cap screws are severely damaged to varying degrees.

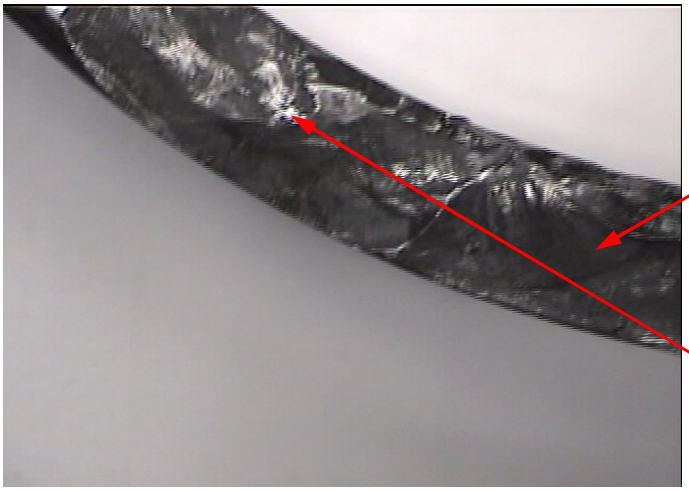

PHOTO No. 8

This is a close-up view of the fractured edge of the outer bearing race.

The clean fracture surface indicates a sudden failure sending "Splintered" pieces within the bearing housing.

The smooth, polished surfaces indicate that the retainer was being worn by part fragments during operation.

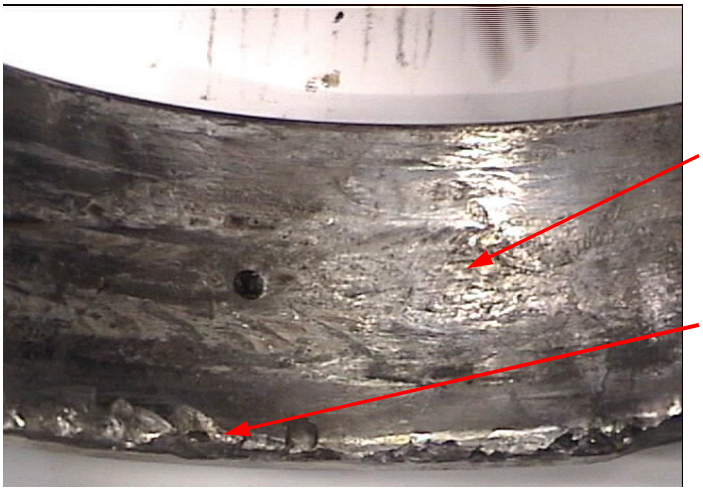

PHOTO No. 9

Close-up view of the roller contact surface of the outer race.
Notice severe flaking, spalling and denting of the rolling surface indicating a rather sudden catastrophic failure.

Notice the fractured but polished edge indicating that broken pieces, grit or other debris or contamination created a "Polishing" effect during operation.

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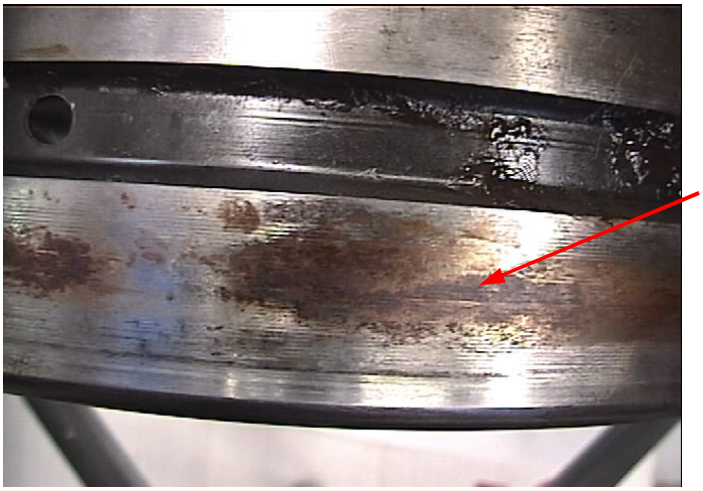

PHOTO No. 10

This is a close-up view of the outside surface of the outer bearing race.

Notice the patches of discoloration and spin marks on the circumference of the outer race.

This indicates that the outer race was moving/slipping within the housing and was also subjected to hot spots.

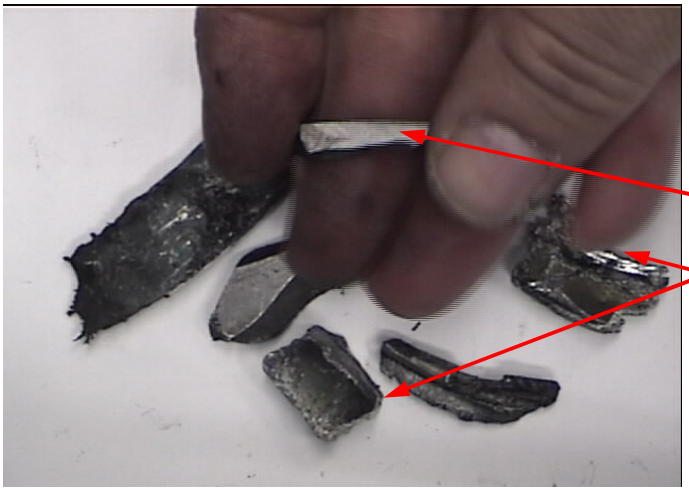

PHOTO No. 11

This photo depicts some of the "Splintered" pieces of the outer race ranging in size from 3/4" to 2 1/4" long.
Some pieces are clean sudden fractures, as that held in hand, with no signs of wear.
Other pieces are severely worn and polished.
Very small slivers of magnetic metal were also observed to be suspended within the grease still on the bearing fragments.

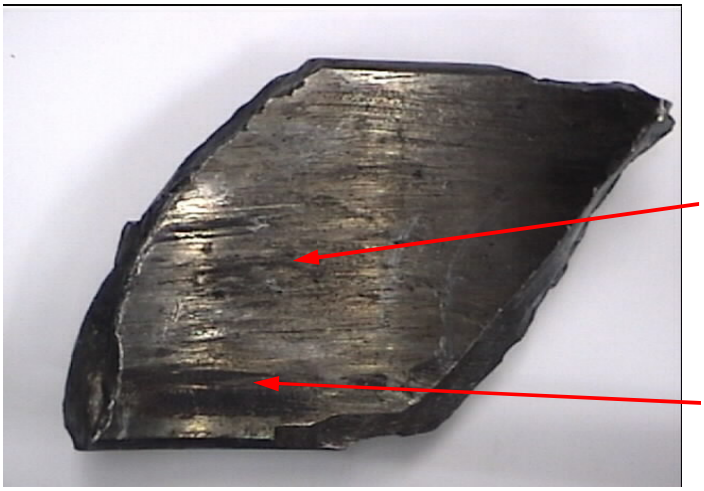

PHOTO No. 12

This photo depicts a fragment of the bearing inner race.

Notice the signs of slipping/rotation on the shaft mating surface. This generated the extreme heat and galling of the shaft depicted in photos 4 and 5 above.

Notice the discoloration depicting the high heat from friction.

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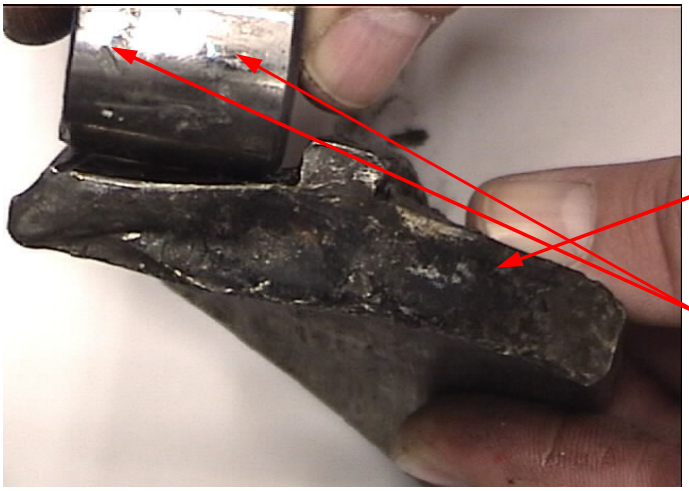

PHOTO No. 13

This is a close-up end view of the inner bearing race shown in photo 12 above.

Notice the severe discoloration.
Notice how the spherical roller would fit on the race.
Notice the severe denting and spalling on the roller.
The remaining grease on the inner race had magnetic slivers suspended within it.

PHOTO No. 14

This photo depicts fragments of the bearing roller cage.
These pieces depict severe wear marks.
These pieces were observed to be extremely light in weight. When tested with a magnet, they were not magnetic.
This cage is probably aluminum.
Roller cages for severe service bearings are typically made of brass or steel.

PHOTO No. 15

This is a photo of 3 out of the 4 bearing retainer cap screws. All of the cap screws were sheared off at the shaft end.
The cap screws show varying degrees of wear and polishing. These cap screws were tumbling around within the bearing housing for some time after they sheared off the shaft.

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PHOTO No. 16

This photo depicts the most severely worn retainer cap screw.

Notice the severe wear marks from being ground up by moving parts within the bearing housing.

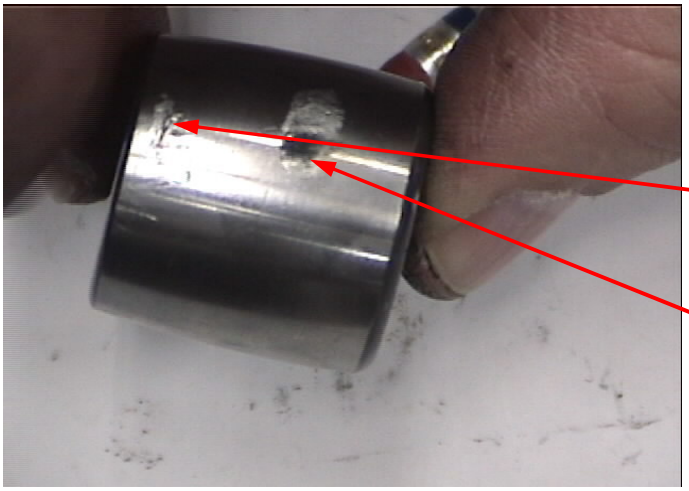

PHOTO No. 17

This is a photo of one of the spherical rollers.

Notice indentations which is due to foreign matter in the bearing.

This patch on the roller is physical metal removal due to sliding of the roller during initia seizure.

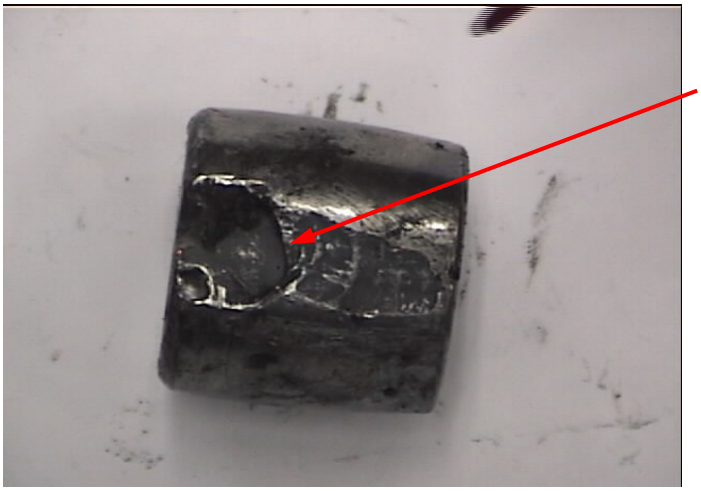

PHOTO No. 18

This photo depicts a spherical roller with a relatively large section of the roller surface just literally broken away.

This is not due to wear but, rather, due to a sudden failure due to foreign particle/s within the bearing rolling surfaces.

There is no discoloration due to heat.

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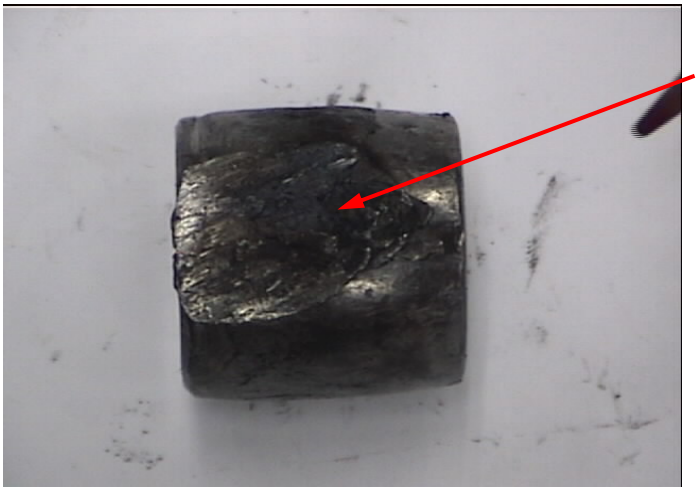

PHOTO No. 19

This photo depicts a roller with extreme discoloration and a large rough area where the roller was sliding during advanced seizure of the bearing. The bearing components were extremely hot at this point. Softening of the bearing races and rollers occur at this point which appreciably accelerates wear.

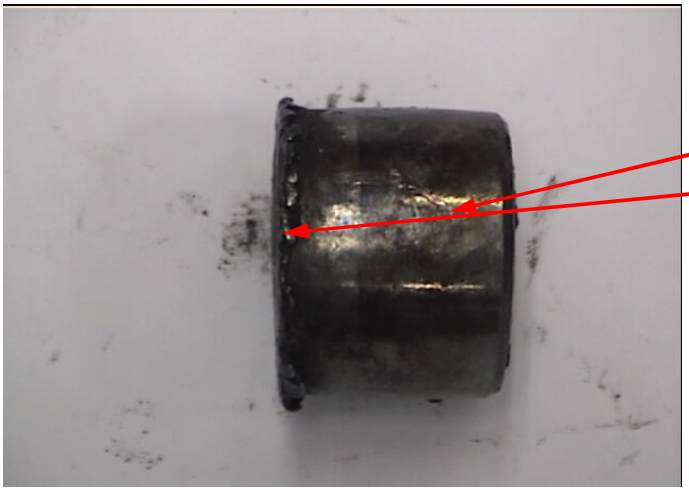

PHOTO No. 20

This photo depicts wear on a spherical roller for an appreciably long time.
The roller is very discolored.
One edge of the roller is severely worn, mushroomed and discolored due to softening of the metal due to extremely high heat.

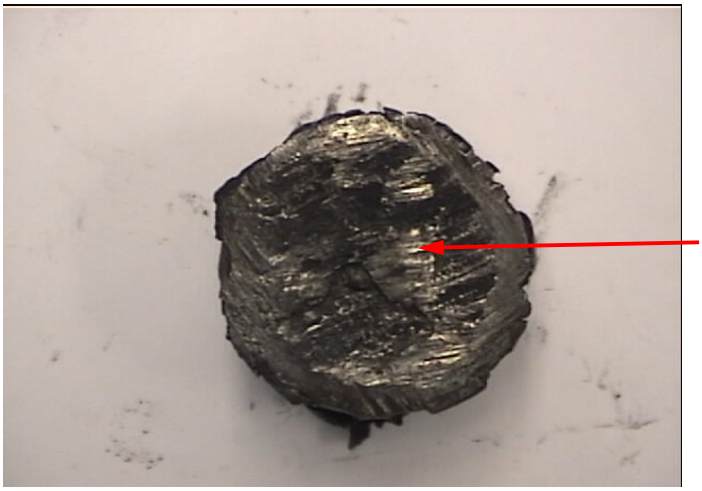

PHOTO No. 21

This photo depicts the mushroomed end of the spherical roller shown in photo 20 above.

Notice the severe wear marks on the end of this roller.

This roller was subjected to physical wear from moving parts for a long time.

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Conclusions of Field Inspection and Observations:

After review of the field data, information provided by Client, drawings and review of basic design data, the following conclusions have been drawn:

1- Since this bearing failure is not frequent or on any short periodic basis, the bearing capacity or rating is not in question for this application.

2- The cracked outer rim and hot spots indicate that the bearing housing may have been distorted thereby not providing proper support of the bearing. This is typically what causes cracks in the outer rim.

3- The severe denting and fractured portions of the bearing rollers depict that there were foreign particles present.

4- Both the inner race and, most importantly, the outer race had small or splintered pieces.

5- Very small magnetic slivers were found in some of the grease that was still on the bearing fragments.

6- The bearing roller cage was observed to be aluminum which is unusual for heavy duty applications. Typically, heavy duty bearing applications utilize brass or steel roller cages with steel roller cages preferred.

7- **Based on the visual inspection of the failed bearing, this particular bearing failure was most likely due to the outer race of the bearing fracturing and splintering at the outer race seating shoulder due to inadequate support of the housing. These outer race splinters or fragments were introduced into the rolling surfaces of the bearing thereby contaminatihg the bearing and initiated the failure of the bearing. It is also possible that contamination could have been initiated from outside of the bearing such as contaminated grease or debris introduced into the bearing during repairs or rebuilding.**

Please contact Rolando Ionta at (216) 485-3704 if you have any questions concerning this report.

Thank You

Rolando Ionta, P.E.