

Notes from Conference Call with Federal Mogul on the Production of the Next Batch of Sequence VIII Bearings

Date: March 11, 2016

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Members Present:

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A conference call was held with Federal Mogul to discuss the list of questions that the Bearing Task Force identified on the February 5, 2016 conference call. Chairman Lang, representing the Bearing Task Force, presented the following questions to the Federal Mogul representatives:

- 1) Has the same vintage of powder been used over time or does the source of the elements used in the powder change over time, i.e., are supplier changes typical?

Answer: They typically use the same supplier for many years but supplier changes do happen.

- 2) Is there any gauge on the purity of the elements in the powder?

Answer: They purchase certified stock to make the powder mix. The concentration of the stock is checked in the powder mix but they are not checking the purity of the individual elements since it is certified by the supplier.

- 3) Does the grain size of the powder matter and if so does it change the post-sintering distribution of the copper and lead?

Answer: When making the powder mix, they do screen off the coarse particles. However, the size of the particles in the powder form is not critical once the powder is melted, i.e., once the powder is molten the matrix is not affected by the pre-phase change particle size.

- 4) Is it possible to rebore/rebroach bearings that have already been bored/broached? We are curious to see if we can 'resurface' the 08-15 bearings and see if they perform differently.

Answer: Once a bearing is removed from the original broaching fixture it is almost impossible to rebroach it. Typically there are alignment problems which will yield inconsistent bearing thickness. As a result they don't recommend this as an option.

The additional question was asked about boring vs. broaching and if we could get a small population of the next batch bored. FM commented that boring is an option but it was noted that the final surface would be very different than that of a broached bearing. Broaching and boring are very different processes and can't be done on the same production line at the same time. If a set population of bearings is desired to be bored they will have to be taken to a different line that will involve additional setup.

- 5) In older batch productions, we would change the broach after a predetermined number of cuts on that broach and that count would constitute a lot within a batch. At the time we were making a much larger batch but perhaps it would be worth changing the broach often on a smaller batch.

Answer: The post production surface analysis using the SEM images on the 08-15 bearing batch show normal lead pull-out which suggests that the broach was still sufficiently sharp. They do not think that the broach was a problem with this batch.

- 6) Would it be possible to prepare three different powder concentrations and use all three on the same bearing run? Specifically, just feed the three concentrations in succession with a distinct break or mark to identify the separation?

Answer: It would be very difficult to intentionally move the powder concentration to a specific level. Additionally, they do not make a powder batch for one specific job. They have a stock of the H-24 powder made in a large quantity and it is used as needed for multiple jobs. In general, they are not comfortable with making modifications to the powder concentration due to the already narrow production range that they are required to adhere to. Looking at the powder concentrations (see table below) from the previous batches they noted that the 01-09 batch had the same lead content as the 08-15. They thought that was confirmation that the powder concentration was not the source of the problem.

The additional question was asked regarding the lower tin content in the 08-15 that was identified by the SEM cross-section analysis. FM commented very firmly that it is their opinion that the small difference in tin is not affecting the bearing performance.

Sequence VIII Powder Concentration Summary				
Batch ID	01-09	09-10	08-15	Spec %
Lead %	23.36	24.79	23.40	21 - 27
Tin %	0.94	1.05	0.98	0.6 - 1.25
Copper	Balance	Balance	Balance	Balance
Note: Table shows raw powder analysis by Federal Mogul				

7) What is the minimum number of bearings halves that can be made in one production run?

Answer: Federal Mogul could not answer this question on the call; they will get back to us after reviewing the with the production manager for the line they will be run on.

Summary:

The bottom line here is that there are not a lot of options on what we can change in the production process of the next batch. Federal Mogul is not comfortable with targeting a specific powder concentration especially since we have a successful batch with the same concentrations as the 08-15 batch (question 6 above).

Recommendation:

Like most of you, I don't like the idea of gambling with making another batch and hoping the outcome will be different without changing something. However, with the resident experts on the issue and not being able to identify the root cause of the performance difference, we still have to take some action to keep moving forward. The recommendation from the group is that we move forward with normal production and entertain the option manufacturing a smaller batch to mitigate losses if the second batch performs the same as the 08-15.