

# A Comparative Study of Mobilith SHC 100 and Gulf Crown EP 2 Greases on the Train Wheel Bearings

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## Abstract

A bearing is a part that reduces the friction that builds up between moving parts. The proper type of grease must be considered to provide a long bearing life. This study aims to analyze the differences between Mobilith SHC 100 and Gulf Crown EP 2 greases. This study employed a laboratory test method conducted at PT Petrolab Services with the test parameters of base oil viscosity, dropping point, and worked penetration at 25°C. Further, as the supporting data, a comparison of the bearing repairs was executed at Balai Yasa Manggarai using Gulf Crown EP 2 grease in 2018 and Mobilith SHC 100 in 2021. The study results suggested that Mobilith SHC 100 grease offered more advantages in maintaining its characteristic stability compared to Gulf Crown EP 2. Moreover, the bearing repairs at Balai Yasa Manggarai in 2018 and 2021 indicated that Mobilith SHC 100 had fewer bearing repairs and higher maximum mileage than Gulf Crown EP 2.

**Keywords:** Base Oil Viscosity, Bearing, Dropping Point, Grease, Worked Penetration At 25 °C, **Aditif**.

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## 1. Introduction

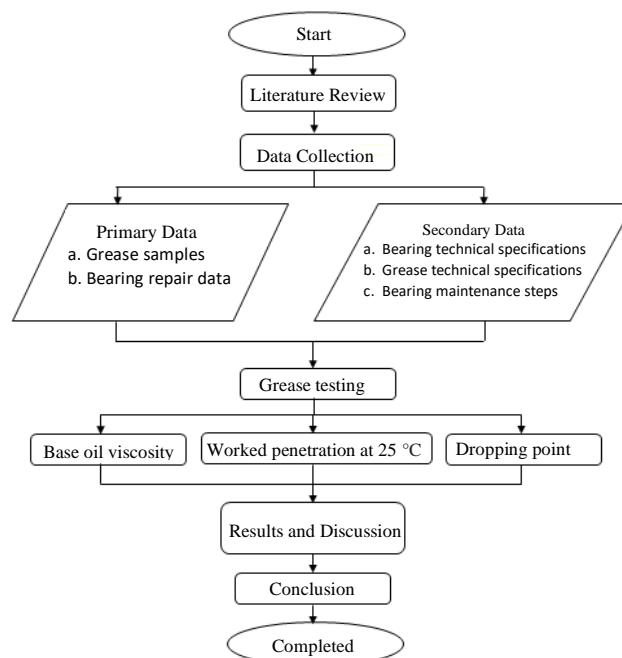
Maintenance serves as an improvement effort to achieve maximum performance (Mattjik, 2015). Maintenance can be made in a wide range of practices, such as spare part replacement, modification, and adjustment to maintain the proper condition of the train and fit for the operation. In the case of trains, one of the maintenance practices is made on the bearing. A bearing refers to a component that minimizes friction between components by passing over the rotation through rotating components on the bearings (Handoko, 2020). The use of bearings in trains can be identified, among others, on the bogies on the wheels to keep the axles from scraping against the wheels; thus, the wheels and axles may have

a longer operational lifetime. The operation or application of bearings can be classified into two types, i.e., contact bearings and non-contact bearings. Contact bearings signify a bearing type in which the mechanism contacts or rubs against other components. On the other hand, non-contact bearings denote a bearing type that adopts a magnet or fluid to connect the outer and inner parts. However, the train wheels generally adopt the contact bearing type.

Bearings on the train wheels obviously require maintenance to enable optimum performance during operation. One of the maintenance practices is the application of grease to the bearings. Greases are materials used to lubricate components that rub against each other to prevent those components from quickly being worn out and enable uninterrupted movement; thus, the wheels/components with bearings can be more durable. (Sinarep, 2011). Melted bearings become one of the issues that commonly occur to bearings. (PT KAI, 2022). Melted bearings result from low-viscosity grease due to overheating; thus, the grease thickener fails to hold the base oil to return to its original state. Such a case can arise from the improper grease type used. Recently, Balai Yasa Manggarai utilized Mobilith SHC 100 to replace Gulf Crown EP 2. Each type of grease offers different characteristics. According to Pribadi et al. (2020), when the lubricant temperature rises beyond its specifications, the lubricant will experience a change in viscosity, after which the lubricant will oxidize so that it cannot maintain its shape. Furthermore, according to Sinarep (2011), bearings with TiN ion implantation did not experience an increase in wear volume compared to those without implantation, which experienced an increase in wear volume. Likewise, Ikhsan et al. (2020) stated that the highest amplitude in the test after lubrication (oil) and personal frequency before and after lubrication (oil & grease) is in the Y-axis measurement position and the least in the X-axis. From some of the literature, it is known that differences in grease characteristics can affect bearing quality. In this study, we will analyze the type of grease through working penetration testing, base oil viscosity, and dropping point on grease.

## 2. Research Method

### 2.1. Flow Chart



**Figure 1.** Flow chart

## 2.1. Tools and Materials

The grease testing at PT Petrolab Services laboratory required a sample of new Mobilith SHC 100 grease of 1.5 kg. The sample containers comprised two bottles of 600 ml and one bottle of 330 ml. The grease testing at PT Petrolab Services laboratory required a sample of new Gulf Crown EP 2 grease of 1.5 kg. The sample containers comprised two bottles of 600 ml and one bottle of 330 ml. The grease testing at PT Petrolab Services laboratory required a sample of used Mobilith SHC 100 grease of 50 grams. The sample container used was a small bottle of 330 ml, which was not fully filled or collected from merely one bearing. The grease testing at PT Petrolab Services laboratory required a sample of 50 grams of used grease. The sample container used was a small bottle of 330 ml.



Figure 2. (a) Sample of New Mobilith SHC 100 (b) Grease Sample of New Gulf Crown EP 2 Grease (c) Sample of Used Mobilith SHC 100 Grease (d) Sample of Used Gulf Crown EP 2 Grease

## 2.1. Test Methode

In this research, the grease testing was conducted at PT Petrolab Services laboratory, located at Jalan Pisangan Lama 3, Number 28, Jatinegara, RT 09/RW 03, Pisangan Timur, Pulo Gadung, East Jakarta, Special Capital Region of Jakarta, postal code 13230. PT Petrolab Services laboratory is an accredited independent laboratory that provides a wide range of petroleum, lubricant, fuel, and calibration analyses. PT Petrolab Services is a used oil and fuel analysis commercial laboratory accredited by the National Accreditation Body of Indonesia (LP-522-IDN) based on the International Laboratory Quality Management System Standard (ISO 17025: 2017). The following testing was performed in the laboratory.

**Table 1.** Testing Methode

Samples	Parameters	Standard
New mobility SHC 100 grease	Base oil viscosity at 40 °C and 100 °C	ASTM D128
	Dropping point	ASTM D566-20
	Worked Penetration at 25 °C	ASTM D217-10
New Gulf Crown EP 2 Grease	Base oil viscosity at 40 °C and 100 °C	ASTM D128
	Dropping point	ASTM D566-20
	Worked Penetration at 25 °C	ASTM D217-10

Samples	Parameters	Standard
Used Mobilith SHC 100 Grease	Dropping point	ASTM D566-20
Used Gulf Crown EP 2 Grease	Dropping point	ASTM D566-20

### 3. Results And Discussion

Based on the graph in Figure 5, it can be perceived that in the worked penetration at 25 °C, the new Mobilith SHC 100 grease had a higher value than the new Gulf Crown EP 2 grease, with values of 288 and 281 mm, respectively. This work penetration aims to determine the consistency level of the grease being tested. The consistency level of the grease itself can be classified based on the National Lubricating Grease Institute (NLGI). The following is the NLGI classification presented in Table 2.

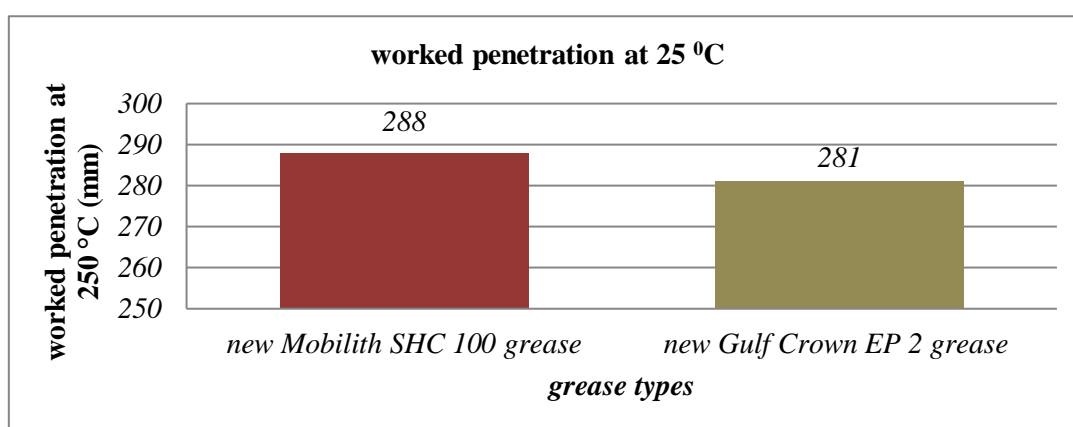


Figure 2. Worked penetration graph

Table 2. NLGI Classification

NLGI Grade	ASTM D217 – worked penetration at 25 °C (77 °F)	Consistency
000	445 – 475	Very fluid
00	400 – 300	Fluid
0	355 – 385	Semi-fluid
1	310 – 340	Very soft
2	265 – 295	Soft
3	220 – 250	Semi firm
4	175 – 205	Firm
5	130 – 160	Very firm

NLGI Grade	ASTM D217 – worked penetration at 25 °C (77 °F)	Consistency
6	85 – 115	Very hard

According to (SNI, 2005) Based on the specifications of the physical-chemical characteristics and the performance parameters of grease lubricants, the permitted NLGI grades range from NLGI grade 1 to NLGI grade 3. Table 4.5, regarding NLGI grades, shows that in grade 3, the value of the worked penetration at 25 °C ranges from 220 mm to 225 mm, while in NLGI grade 1, the value ranges from 310 mm to 340 mm. Therefore, to comply with the Indonesian National Standard, the limit value of worked penetration at 25 °C should range from 220 mm to 340 mm. The NLGI number level is adjusted to the needs or application. The application of tapered bearing unit or tapered roller bearings on train wheels was in accordance with the description, namely NLGI grade 2 or worked penetration at 25 °C of 265 mm to 295 mm. Meanwhile, the test results on Mobilith SHC 100 and Gulf Crown EP 2 greases using the worked penetration at 25 °C obtained a value of 288 mm and 281 mm. Based on the test results, a better grease can be determined from the value of the worked penetration at 25 °C with a larger value since the smaller the value obtained from the worked penetration test at 25 °C, the thinner or more fluid the grease will be. Therefore, in this test, the grease with better consistency characteristics was the Mobilith SHC 100 because it had a greater result than Gulf Crown EP 2.

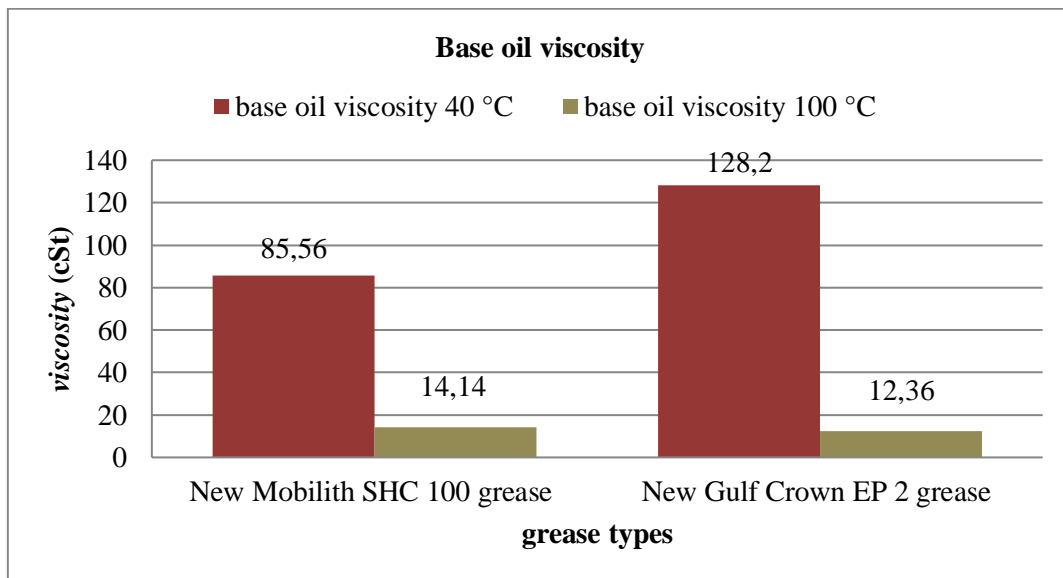
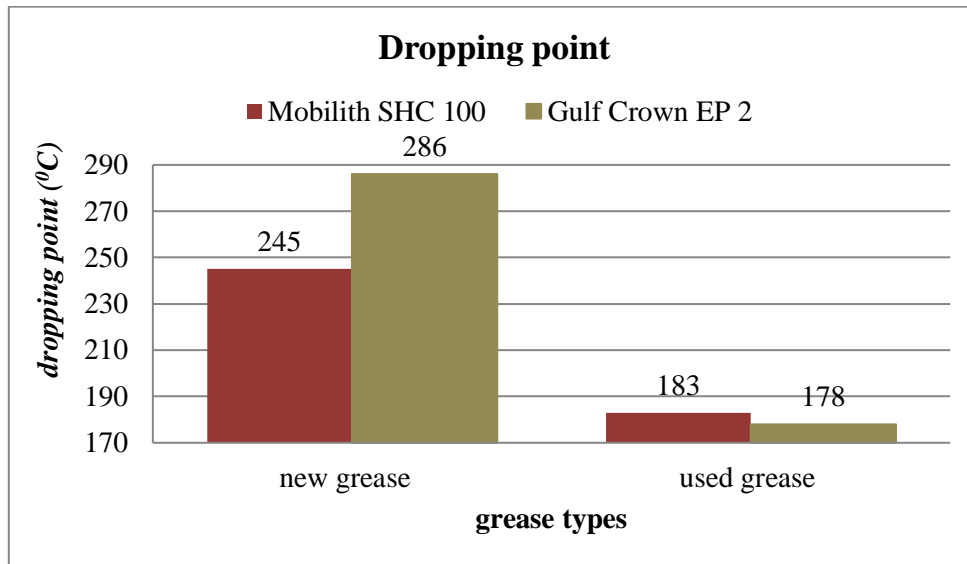


Figure 3. Bar chart of base oil viscosity test

Based on Figure 3, it can be understood that based on the base oil viscosity at 40 °C, the new Mobilith SHC 100 grease has a lower value than Gulf Crown EP 2. Meanwhile, based on the base oil viscosity test at 100 °C, the new Mobilith SHC 100 grease obtains a higher viscosity than the new Gulf Crown EP 2 grease. The higher the base oil viscosity, the higher the viscosity level of the grease. The test results implied that Mobilith SHC 100 had stability in maintaining its base oil viscosity because the decrease in its viscosity was lower than Gulf Crown EP 2.



**Figure 1.** Bar chart of dropping point test

According to (SNI, 2005), based on the specifications of the physical-chemical characteristics and performance parameters of grease lubricants, the allowed dropping point is 80 °C at a minimum using the ASTM (American Standard Testing and Material) D566 test method. In accordance with the standard, both new and used Mobilith SHC 100 and Gulf Crown EP 2 greases met the dropping point standard set by the Indonesian National Standard (SNI). The higher the dropping point value of the grease, the better the resistance of the grease in maintaining its structure not to melt. Contrarily, if the grease has a low dropping point value and works at an operating temperature above its dropping point, the grease can lose its function due to melting. Based on the chart in Figure 4.11 concerning the result of the dropping point test for the new grease, Mobilith SHC 100 has a higher dropping point. Meanwhile, the result of the dropping point test for the used grease shows that Gulf Crown EP 2 has a higher dropping point. It is possible since Mobilith SHC 100 has good stability in maintaining its dropping point.

The bearing repair data used was obtained from the repair data at Balai Yasa Manggarai. The data collection was conducted to allow a more relevant comparison since the grease sampling was also conducted at Balai Yasa Manggarai. The bearing repair data used consisted of the bearing repair data when using Gulf Crown EP 2 in 2018 and Mobilith SHC 100 in 2021.

**Table 3.** Bearing repair data

Year	2018	2021
Number of bearing repairs	37	122
Highest mileage	371,125 km	660,883 km

Based on the bearing repair data obtained from the use of Gulf Crown EP 2 at Balai Yasa Manggarai in 2018, the bearing repairs were conducted 122 times that year. Meanwhile, in 2021, bearing repairs using Mobilith SHC 100 were conducted 37 times. In addition, the highest mileage achieved using Gulf Crown EP 2 was 371,125 km, and the highest mileage using Mobilith SHC 100 was 660,883 km, according to the number of bearing repairs and mileage when the train utilized Gulf Crown EP 2 in 2018 and Mobilith SHC 100 in 2021 at Balai Yasa Manggarai, it can be concluded that Mobilith SHC 100

had better performance than Gulf Crown EP 2 in the grease utilization on the tapered bearing unit of the train wheels.

## 4. Conclusion

Based on the tool design process and the results of tool testing that has been carried out by the author, conclusions can be drawn, namely: Design a fire detection device on an electrical panel automatically using IoT with the NodeMCU ESP8266 microcontroller by utilizing two sensors, namely the DHT11 sensor, as well as the MQ-2 sensor with buzzer output, 16x2 LCD, and Firebase real-time database, in the design of an automatic fire detection tool using IoT utilizing the DHT11 sensor and MQ-2 sensor. Both sensors can carry out their respective functions, but the two sensors are not connected to each other, so if damage occurs to one of the sensors, the device can still function properly. This fire detection system uses a 16x2 LCD screen, which functions as local monitoring on the electrical panel, and a Firebase real-time database, which is used to monitor humidity, temperature, smoke, and gas on the electrical panel so that users of this tool can monitor the condition of the electrical panel. In real time, therefore if conditions are abnormal they can be handled immediately. Furthermore, this fire detection system is equipped with a buzzer that can sound to alert the device owner if a fire hazard occurs. The output values from these two sensors can be seen via the Firebase real-time database so that users of this device can easily monitor this fire detection tool at any time.

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