



## Design and Build Special Service Tools for Removing and Install the Drive Shaft for the Komatsu HD785-7 Dump Truck

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<https://doi.org/10.37339/e-komtek.v8i1.1857>

Published by Politeknik Piksi Ganesha Indonesia

### Artikel Info

Submitted:

06-07-2024

Revised:

09-07-2024

Accepted:

10-07-2024

Online first :

10-07-2024

### Abstract

One of the repair works on the Power Train Havy Dum Truck (HD 787-5) unit is general overhaul work, which includes replacing components or overhauling the final drive assembly unit. The solution to the uninstallation and installation work is to replace the final drive. The disassembly and assembly work process has a level of difficulty, so technicians need precision and accuracy in assembling the drive shaft on the final drive so that the time for this work process requires a long lead time. components) and has potential K3 hazards for technicians (manpower). The difficulty of inserting the drive shaft into the differential gear and rotating the ring gear in the final drive is a problem due to the long processing time. The innovation carried out is how to position the drift shaft parallel to the position of the differential gear, thus requiring a special tool to leverage and at the same time to rotate the drive shaft so that it can change the position of the position, with this leverage and position change effort it can speed up the removal and installation process and working time technicians are more effective and efficient in terms of labor costs on general overhaul work.

*Keywords:* Special Service Tools, Final Drive, Power Train HD 785-7

### Abstrak

Salah satu dari pekerjaan perbaikan pada unit *Power Train Havy Dum Truck* (HD 787-5) adalah pekerjaan *general overhaul*, yang meliputi penggantian komponen atau *overhaul* pada unit *final frive assy*. Solusi dari pekerjaan *remove and instal* tersebut adalah dengan mengganti *final drive*, dalam prosesnya pekerjaan pembongkaran dan perakitan komponen memiliki tingkat kesulitan sehingga teknisi memerlukan ketelitian dan kecermatan dalam melakukan upaya perakitan *drive shaft* pada *final drive* sehingga waktu pada proses pekerjaan ini memerlukan waktu yang lama (*leadtime*) dan memiliki potensi bahaya K3 bagi teknisi (*man power*). Sulitnya memasukan *drive shaft* ke *gear differential* dan memutar *ring gear* pada *final drive* menjadi permasalahan dari lamanya waktu pengerjaan. Inovasi yang dilakukan adalah bagaimana memposisikan *drift shaft* sejajar dengan posisi *gear differensial*, dengan demikian dibutuhkan alat khusus untuk mengungkit dan sekaligus untuk memutar *drive shaft* sehingga dapat merubah posisi dari kedudukan, dengan upaya pengungkitan dan perubahan posisi tersebut dapat mempercepat proses *remove and install* dan waktu kerja teknisi lebih efektif dan efisien dari sisi *cost* biaya *manpower* pada pekerjaan *general overhoule*.

*Kata-kata kunci:* Special Service Tools, Final Drive, Power Train HD 785-7



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## 1. Introduction

When carrying out maintenance and repair work on vehicle units, especially on vehicle engines or heavy equipment, it is often necessary to use special tools called special tools. Special tools, called special service tools, are tools that are specifically designed to facilitate work on maintenance, upkeep, and repair of units as well as testing certain parts of engine components and others. The use of special tools is closely related to the efficiency of work and safety in carrying out work for technicians. Previous research carried out by using appropriate work aids, technicians or mechanics can work more effectively and efficiently in the repair process work [1]. Komatsu Dump Truck HD785-7 is a product from Komatsu, this product is widely used in mining processes to transport and move mining materials in mining activities. The HD785-7 unit has a unit empty weight specification of 72,300 kg and a material carrying capacity of 91,000 kg. This unit uses an SAA12V140E-3 engine with a power capacity of 1900 hours power. The transmission used is fully automatic using a planetary shaft type with a speed of 7 speeds for forward and 2 speeds for moving the unit backwards. The axle uses a full floating type [2]. On the HD785-7 unit, the final drive and drive shaft, which are important components for the final drive to the wheels or track, require a long time and are safe for technicians to carry out the process of repair work and component replacement (remove and install).

Final drive is an arrangement of gears which is usually a set of straight gears and/or a set of planetary gears final drive gears function to reduce rotation and increase unit torque, such as in bulldozers, dump trucks, wheel loaders, and other heavy equipment. The HD785-7 uses a planetary gear-type final drive [3]. In a planetary gear type final drive, power from the transmission is transmitted to the differential and the final drive via the final drive shaft component, from the final drive shaft the power enters as a sun gear on the first reduction planetary gear. The ring gear is a static component, so the output is the carrier, from the carrier in the first reduction planetary gear the power is sent to the second reduction planetary gear as a sun gear [8]. The process of installing the drive shaft into the final drive is often hampered because when installing it, the mechanic uses an M20 size bolt which is installed in the bolt hole in the ring gear on the drive shaft and rotates the ring gear by hand and leverages it with a pipe which is considered unsafe. and the narrow gap position makes the process of removing and assembling components take longer.

Several previous studies have been carried out, Abrar, Ali, et al [3]. Making improvements to these special tools was made to simplify and increase safety in the process of dismantling and

installing valves on the cylinder head. This special tool uses a 2-ton mechanical screw jack which is used to press the spring valve and a DC motor as a jack driver which is connected to the gearbox thereby reducing loading and unloading time. Rasma, et al [4]. Design special tools to increase productivity and save costs. In this research, with a case study on the Komatsu PC200-8MO unit, the method used is to design special tools so that it can reduce waste of time in removing and installing track rollers for general overhauls. Success in the industrial world depends greatly on efficiency and productivity [5]. To improve overall performance, it is necessary to develop work systems, tools, and comfortable working conditions. Therefore, this research aims to design special service tools to remove and install drive shafts for the Komatsu HD785-7 dump truck, with the hope of reducing work cycle time.

## 2. Method

Figure 1 shows the 7 Up++ method used as a reference in conducting innovation research. The use of this method ensures that research innovation becomes more focused, easy to implement, and well documented so that research innovation is easier and produces innovative products that can be used as solutions for technicians when carrying out component removal and component assembly work processes. The first step before starting an improvement or innovation project is to carry out the analysis stage followed by the solution stage so that it produces the desired results [6].



Figure 1. 7 Up++ Method

## 3. Results and Discussion

### 3.1. Analysis

This analysis stage is very important because it will determine the quality and impact that will result at the end of the project. In this case, the population used is the population of units at PT X, there are 179 units in Figure 2.

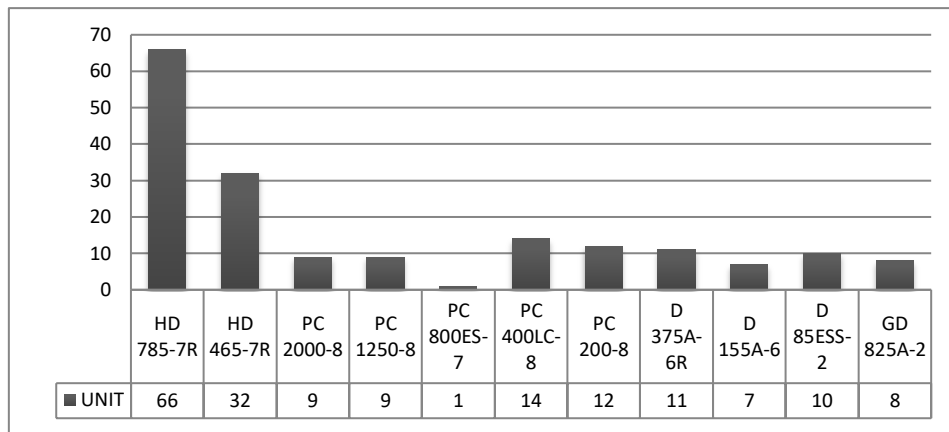


Figure 2. HD 785-7 Unit Population Data

Based on the unit population data above, the use of units with wheel drive is more than those using track shoe drive. The drive shaft is part of the power train which functions to transmit engine power to the wheel axles. During the process of removing and installing the final drive, it is necessary to remove and install the drive shaft. The method used for the process of removing and installing the drive shaft at this time is using M20 size bolts and non-standard pipes which have the potential to cause accidents and use the manpower of 4 people and the time used for this process is  $\pm$  30 minutes. The target of this problem is the creation of a tool that can increase manpower effectiveness and better safety. A fishbone diagram is presented in Figure 3.

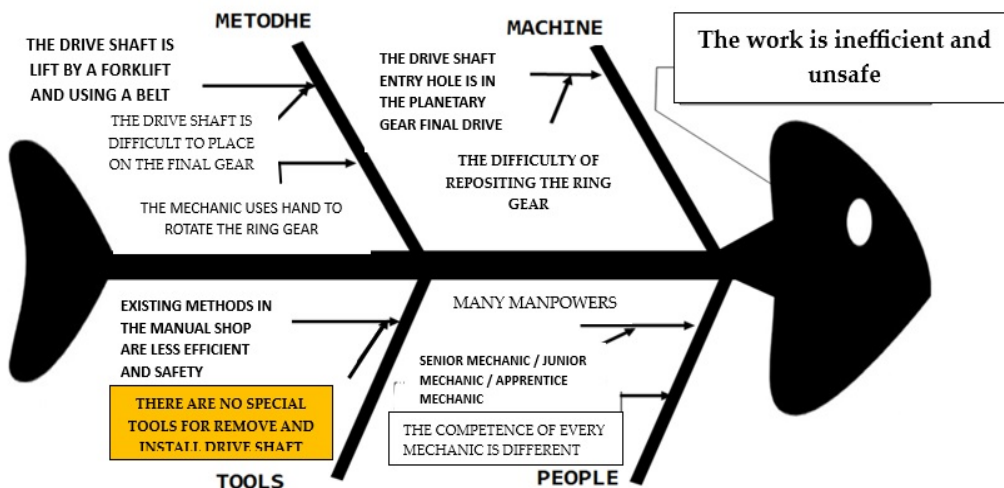


Figure 3. Fishbone Diagram

Based on Figure 3 shown in the fishbone diagram [9], the length of work time carried out by technicians for the process of removing and installing the drive shaft on the HD785-7 can be influenced by several factors, namely technician resources, unit components, methods, and tools used. The main problem that occurs is the difficulty of repositioning the drive shaft to the final

gear. The method used is complicated in the field, while the use of work equipment is considered not safe and efficient.

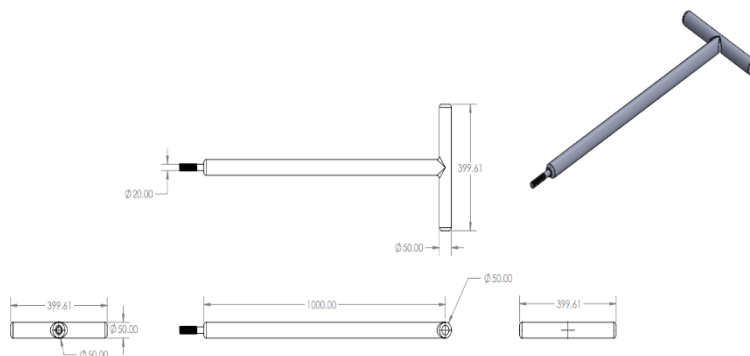
### 3.2. Solution

The next step after carrying out the analysis process is to look for solutions to existing problems, to find an idea for the problem. In the planning process for making special tools for removing and installing the Drive Shaft for the Komatsu HD785-7 Dump Truck using the observation method (field survey) and library research [10 – 15], namely by reviewing the target object and looking at the dimensions in the shop manual. and determine the steps in making tools. The next stage is to create a design plan for the special service tools for removing & installing the drive shaft which is shown in Figure 3. Designing a special service tool for removing & installing the drive shaft requires being able to visualize and know the function of the tool. The ideas of the problems carried out in this research can be seen [Table 1](#).

**Table 1.** Idea Planning

	<i>Root Cause Dominant</i>	<i>Solution</i>	<i>Benefit</i>	<i>Final</i>
<i>People</i>	The competency of each mechanic is different	Increase competency in mechanics	The amount of manpower can be reduced to reduce operational costs	Increase mechanical competency
<i>Tools</i>	There are no special tools available for the process of removing & installing the drive shaft	Design of tools for the process of removing & installing the drive shaft	Tool design can reduce the amount of manpower	Making Tools
<i>Method</i>	Mechanics use their hands to turn the ring gear	Provide socialization on the use of tools	Increase safety at work	Providing Socialization
<i>Machine</i>	Difficulty repositioning the ring gear	Use special tools for the process of removing & installing the drive shaft	Work becomes more efficient	Use of tools for the process of removing & installing the drive shaft

Desain special service tools to remove and install the drive shaft are presented in [Figure 4](#).



**Figure 4.** Desain Special Service Tools Remove and Install Drive Shaft

### 3.3. Result

Testing these Special Tools on the HD785-7 drive shaft by inserting the tip of this tool into the thread in the drive shaft and pushing rotating and repositioning the drive shaft is shown in [Figure 5](#).



**Figure 5.** Trial Service Tools Remove & Install Drive Shaft

The results of innovative ideas and research ideas that were obtained before improvements were made and after improvements were made using special tools for removing and installing the drive shaft are discussed in [Table 2](#).

**Table 2.** Before & After Comparison

<b>Improvement Results</b>	<i>Before</i>	<b>Target</b>	<i>After</i>
The amount of manpower required	4 manpower	Reducing the number of manpower	2 manpower
<i>Safety</i>	Using hands (not safe)	Increased safety at work	Using special tools
Faster processing time	20 – 30 minutes	Pressing time	10 minutes

To carry out the process of removing and installing the drive shaft, 4 people are required, provided that 1 person rotates the propeller shaft, 3 people rotate the ring gear and 2 people pry the pipe as shown in [Figure 6](#).



**Figure 6.** Comparison Before Using Special Tools

After implementation using Special Tools, the process of removing and installing the drive shaft only requires 2 manpower and increases safety very well. The number of manpower in one work requires 4 people. The pay for one manpower per hour is 27\$ and the work time is 30 minutes. Total 4 manpower  $\times 27\$ \times 0.5 = 54\$$  a/ Rp. 775,383.30,-. After there are special tools, the number of manpower in one work becomes 2 people. The pay of one manpower per hour is 27\$. Time difference 30 minutes – 20 minutes = 10 minutes. Total 2 manpower  $\times 27\$ \times 0.166 = 8.964 \$$  / Rp. 128,713.63,-.

#### 4. Conclusion

With the introduction of Special Tools in the process of removing and installing the HD785-7 drive shaft, there are several significant benefits. First, manpower efficiency can be realized by reducing the number of workers from 4 people to 2 people. Work productivity and utilization of labor resources can be optimized with the use of special tools and product innovations in this research. Second, the safety aspect is better because using this tool reduces the potential for accidents that may occur during the process of removing and installing the drive shaft. This contributes to the protection and welfare of workers. Finally, financially, the use of this special tool results in significant savings with expenses decreasing drastically, from Rp. 775,383.30.- to Rp. 128,713.63.-. Thus, the application of Special Tools can increase efficiency in work operations but can also have a positive impact on security aspects and overall company expenses.

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