

V-BELT LIFETIME ANALYSIS OF BUS VEHICLES ENGINE CAPACITY 7684 CC REAR ENGINE

Kis Yoga Utomo¹

¹Mechanical Engineering Study Program, Faculty of Engineering, Krisnadwipayana University , Bekasi, Indonesia
Email : yogaautomo760@gmail.com

ABSTRACT

Analysis of the durability of the *v-belt* of bus vehicles with a capacity of 7684 cc *Rear Engine*. The *v-belt* used is *COG* type with type C (22 x 14). There are several factors that affect the life of the *v-belt* , namely, the straightness of the *v-belt* with the pulley, the heat received by the *v-belt* with a standard – 30 °C / + 90 °C , the tightness or flexibility of the *v-belt*, the distance traveled and the time taken. traversed by vehicles, pulley wear and *v-belt wear*. test the hardness of the rubber material and the heat resistance of the *v-belt* by using an infrared thermometer measuring instrument and determine the physical condition of the *v-belt* by testing rubber materials using a shore durometer D measuring instrument and based on a distance of 50,000 kilometers (Low). The results of the average *v-belt rubber hardness test* are 57.5 shore durometer D, from the average results The average hardness test of rubber *v-belt* at a distance of 100,000 kilometers (Medium) obtained the results of 60.7 shore durometer D. On an average of 140,000 kilometers (High) there was an increase from the standard 55 Shore durometer D increased to 62.5 Shore durometer D and the physical condition of the *v-belt* is wearing and cracking at the bottom of the *v-belt* . The *v-belt* wears out at the bottom width of the *v-belt* at a distance of 50,000 kilometers, 100,000 kilometers and 140,000 kilometers. At the top width *v-belt* wears out at 140,000 kilometers. So as to prevent the *v-belt* from breaking when the vehicle is operating at a mileage of 140,000 kilometers the *v-belt* had to be replaced. If the *v-belt* breaks while the engine is operating, it will cause a very dangerous disturbance to the bus engine cooling system. With all the existing factors, the result of the age of the *v-belt* with the normal condition of the unit or SOP and the vehicle operating normally is 4 months 5 days 9.6 hours.

Keywords: *v-belt , Shore , Durometer , Hardness , Tester.*

INTRODUCTION

To deliver [1] power [2] and rotation in a mechanical system [3] , a transmission system [4] is needed , for example belts [5] , gears [6] , friction wheels [7] . This transmission system delivers power and rotation from one shaft to another [8] . Such systems are often found in everyday life, for example in motorized vehicles [9] [10] , industrial equipment, and so on. One of the transmission systems on bus vehicles uses a belt system [11] [12] . The advantages of using belts are that they are inexpensive, easy to install, and do not require lubrication [13] . Belts that are commonly used are belts with a trapezoidal cross-section model [14] or often

called " *V-belts* " but the use of this *V-belt* has a weakness, namely the rotation that is delivered is not constant, because there is slip between the belt and the pulley. Therefore, this bus vehicle is designed by the factory using a *V-belt* gear . with the presence of teeth on the surface of the belt, which then hooks on the pulley so that the engine speed does not slip on the belt and the transmission system [15] becomes constant.

The age or age of the belt resistance in bus vehicles is very influential [16] , because the belt as a transmission rotates the fan in the cooling system for the engine, charging system and air conditioning cooling system. So, in this paper, we discuss the age resistance test against the use of *V-belts* on bus vehicles with a capacity of 7684cc.

THEORETICAL FRAMEWORK

A. Belt – V

Belt - V or V-Belt is one of the transmission media power on a forming machine _ a composed belt _ of rubber material and has cross section trapezoid nor rectangle in accordance with types , types and uses . V-Belt driven by force swiipe drive , v-belt capability for move power depends on (v-belt speed , friction between v-belt and pulley, Belt tension to pulley, Angle contact Among belt and pulley) [16]

B. V-belt usage

Belt used for move power from one axis to another axis on rotation same or different with intermediary pulley . V-belt must capable transmit great power _ without slips. V-belt has cross section trapezoid made of from ingredient durable kevlar _ swiipe and hold hot . Types of V- belts in automotive if seen there is four V-belt type . Namely Raw Edge V-belt, Timing V-belt, Poly V-belt, and Variable Speed V-belt.

Inner V- belt transmit power Keep going rub together with pulley , so the V-belt must be checked by periodically . In the v belt . manual checked every 10,000 Km and replaced every 25,000 Km or V-belt already wear. Standard size V-belt width is 18.2 mm with a limit of 17.2 mm. V-belt that has been worn be marked with cracked and wide V-belt already exceed the limit then must replaced with the new [17] .

C. Profit Use of V-belt

Profit from this machine that uses pulley and v-belt is no cause voice noisy , cost relative care _ more inexpensive compared with drive that uses gear and chains [18] .

D. Loss Use of V-belt

rapezium aitu power generated _ no so strong like use transmission with wheel teeth . V-belt made from designed rubber _ so appearance until cross section forming a trapezium [18]

RESEARCH METHODS

Research _ it uses theoretical methods and engineering research methods where data collection is based on field observations, interviews, literature studies, data collection and

literature review. The composition of this method includes the object of observation and material testing with the title, "Analysis of *V-belt* Lifespan for Bus Vehicles with 7684 CC *Rear Engine Capacity*".

A. Flowchart _

For knowing plot this research activity and process , and for make it easy writing in plan analysis study manipulation this so plot activity depicted with flowcharts.

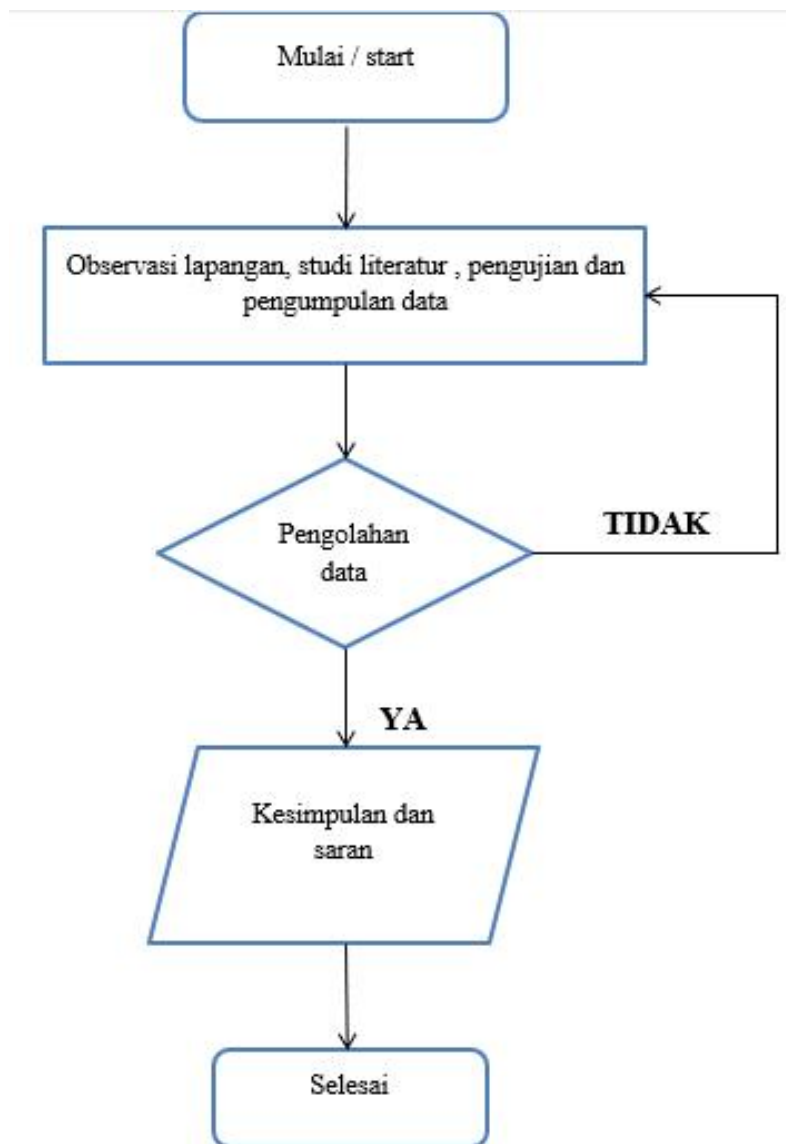


Figure 1. Flowchart Study

DISCUSSION

A. Type C . *V-belt* heat resistance test

Based on testing done , got _ results testing endurance heat V- belt on round engine 1500 rpm as following .

Table 1. *V-belt* heat resistance test results

HEAT RESISTANCE TEST ON V-BELT RECMF-9860 AT 1500 RPM	
TIME (HOUR)	TEMPERATURE (°C)
1	42.4
2	44.2
3	44.4
4	44.6
5	45.2
6	46.8
7	50.4
8	52.6
9	53.6
10	55
11	59.6
12	61

B. *V-belt* rubber hardness test Type C

Based on the tests carried out, the results of rubber hardness testing using Shore Durometer D are as follows:

Table 2. *V-belt* . rubber hardness test results

SHORE DUROMETER D (ShD) TEST DATA ON V-BELT RECMF-9860				
No	Bus Unit	50,000 km (Low)	100,000 km (Medium)	140,000 km (High)
1.	Bus 1	57	60	62
2.	Bus 2	57	61	63
3.	Bus 3	58	61	63
Average		57.5	60.4	62.5

C. Calculation of life expectancy of Type C V-belt

Based on the data obtained at the company in replacing *the v-belt* for the Jakarta – Jogjakarta bus route (557.5 km), the average mileage of the *V-belt replacement* is 140.00 km .

D. v-belt lifespan according to SOP

Is known :

- V-belt replacement distance = 140,000 km
- Travel time 1 trip = 1 day
- 1 trip distance = 1115 km/day
- Answered

$$= \frac{140.000 \text{ km}}{1115 \text{ km/hari}}$$

$$= 125.5 \text{ days}$$

$$= \frac{125,5 \text{ hari}}{30 \text{ hari}} = 4.18 \text{ months}$$

$$= 0.18 \text{ months} \times 30 \text{ days} = 5.4 \text{ days}$$

$$= 0.4 \text{ days} \times 24 \text{ hours} = 9.6 \text{ hours}$$

So the age resistance of the v-belt in the normal unit is 4 months 5 days 9.6 hours

E. Calculation of age factors V-belt

Is known :

- Drive pulley diameter (D_1) = 200 mm = 0.2 m
- Driven pulley diameter (D_2) = 200 mm = 0.2 m
- Rotation (n) = 1500 rpm
- Shaft axis distance (x) = 81 cm = 810 mm
- Drive pulley radius (R_1) = 100 mm
- The radius of the driven pulley (R_2) = 100 mm
- V-belt height (t) = 14 mm = 1.4 cm
- V-belt top width (a) = 22 mm = 2.2 cm
- V-belt bottom width (b) = 14 mm = 1.4 cm
- Allowable V-belt voltage (σ) = 98 N

❖ Belt speed

$$V = \frac{\pi \cdot d_1 \cdot n}{60}$$

$$V = \frac{3,14 \cdot 0,2 \cdot 1500}{60}$$

$$V = 15.7 \text{ m/s}$$

❖ Coefficient of Friction

$$= 0,54 - \frac{42,5}{152,6+V}$$

$$= 0,54 - \frac{42,5}{152,6+15,7}$$

$$= 0.54 - 0.27$$

$$= 0.27$$

❖ *V-belt* length

$$L = \pi (R_1 + R_2) + 2x + \frac{(R_1 - R_2)^2}{x}$$

$$L = 3.14 \cdot (100 + 100) + 2.810 + \frac{(100 - 100)^2}{810}$$

$$L = 628 + 1620$$

$$L = 2248 \text{ mm} = 2.48 \text{ m}$$

❖ Large contact angle

$$180^\circ - 57^\circ \cdot \frac{(D_1 - D_2)}{x}$$

$$180^\circ - 57^\circ \cdot \frac{(200 - 200)}{810}$$

$$180^\circ$$

$$= 180 \frac{\pi}{180}$$

$$3.14 \text{ rad}$$

❖ tension (T_1) and slack stress (T_2)• Belt Cross-sectional Area (A)

$$A = \frac{1}{2} \cdot (a + b) \cdot t$$

$$= \frac{1}{2} \cdot (2.2 + 1.4) \cdot 1.4$$

$$A = 2.52 \text{ cm}^2$$

• Tension tension (T_1)

$$T_1 = A$$

$$= 98 \cdot 2.52$$

$$T_1 = 246.96 \text{ N}$$

• Slack tension (T_2)

$$2.3 \log \frac{T_1}{T_2} = \mu \cdot \theta$$

$$2.3 \log \frac{T_1}{T_2} = 0.27 \cdot 3.14$$

$$\log \frac{T_1}{T_2} = \frac{0.8478}{2.3}$$

$$\log \frac{T_1}{T_2} = 0.368$$

$$\frac{T_1}{T_2} = 2.333 \dots\dots\dots (\text{antilog } 0.368)$$

$$T_2 = \frac{T_1}{2.333}$$

$$T_2 = \frac{246.96}{2.333}$$

$$T_2 = 105.85 \text{ N}$$

CONCLUSION

From the results of testing and discussion in this study, it can be concluded that the factors that occur in the field affect the age of the *V-belt*. And the obtained belt speed is 15.7 m/s, coefficient of friction is 0.27, with a *v-belt length* of 2.48 m, the contact angle is 3.14 rad, tight tension is 246.96 N and slack stress is 105.85 N. Testing The results showed that the rubber hardness of the *V-belt* every 50,000 Km obtained an average increase in the hardness of the rubber to 57.5 ShD. On an average of 100,000 Km, the hardness of rubber increased to 60.7 ShD. On an average of 140,000 Km the hardness of the rubber *V-belt* increased to 62.5 ShD and experienced wear and tear, as well as cracks in the *v-belt*. So to prevent the *v-belt* from breaking when the vehicle is operating, in less than 5 months or a distance of 140,000 Km , the *v-belt* should be replaced .

BIBLIOGRAPHY

- [1] S. Pajriah, "The Role of Human Resources in the Development of Cultural Tourism in Ciamis Regency," *J. Artifacts* , vol. 5, no. 1, p. 25, 2018, doi:10.25157/ja.v5i1.11913.
- [2] U. Zakiyah and IA Idrus, "Ponggok Village Natural Resource Management Strategy," *JIP (Journal of Governmental Science) Kaji. Government Science. and Polit. Dr.* , vol. 2, no. 2, pp. 84–95, 2017, doi:10.24905/jip.2.2.2017.84-95.
- [3] N. Azis, AS Azzahra, A. Muditomo, UA Medika, and J. Timur, "Analysis Of Human Computer Interaction Approach In Pospay Application," *J. Mantik* , vol. 6, no. 36, pp. 1956–1963, 2022.
- [4] NUR Azis, "smartphone . Smartphones," *Intellectiva* , vol. 3, no. 9, pp. 149–158, 2022.
- [5] RH Barus, S. Komar, D. Fuad, and R. Suwardi, "Performance Analysis of Belt Conveyors for Optimization of Nickel Ore Transportation at Pt. Aneka Tambang Tbk Ubpn Pomalaa Performance Analysis of Belt Conveyor To Optimize the Transport of Nickel Ore in Pt. Aneka Tambang Tbk Ubpn Pomalaa," *JP* , vol. 1, no. 4, pp. 48–54, 2017.
- [6] AS Alfauzy, "Production of Gears from Copper and Aluminum Metal Powder with Compaction Process," *J. Mechanical Engineering* , vol. 14, no. 3, p. 121, 2019, doi:10.32497/jrm.v14i3.1641.
- [7] A. Berlian Rms and E. Wahyuningsih, "Analysis of the Frictional Force of Two Homogeneous Objects as a Source of Energy (Case Study: Friction of Electric Train Wheels With Rails)," *J. Tek. and Information.* , vol. 1, no. 1, pp. 41–51, 2021, doi:10.52909/jti.v1i1.10.
- [8] N. Azis, G. Pribadi, and MS Nurcahya, "Analysis and Design of Android-Based Basic English Learning Applications," *J. IKRA-ITH Inform.* , vol. 34, no. 4, pp. 101–108, 2020.
- [9] N. Azis and BA Handoko, "Analysis and Design of Goods Procurement Applications at PT . Sintra," *J. Inf. syst.* , vol. I, no. 2, pp. 38–42, 2021.
- [10] DK Wardani and Rumiayatun, "INFLUENCE OF TAXPAYER KNOWLEDGE, MANDATORY AWARENESS OF MOTOR VEHICLES (Case study of four-wheeled PKB WP in Samsat Drive Thru Bantul)," *J. Akunt.* , vol. 5, no. 1, pp. 15–24, 2017,

- doi:10.24964/ja.v5i1.253.
- [11] N. Azis, Herwanto, and F. Ramadhani, "Implementation of Speech Recognition in E-Prescribing Applications Using Convolutional Neural Network Algorithms," *J. Media Inform. Budidharma*, vol. 5, no. April, pp. 460–467, 2021, doi:10.30865/mib.v5i2.2841.
 - [12] S. Fuada and T. Adiono, "Design of Visible Light Communication Physical Layer in Audio Transmission System," *J. Infotel*, vol. 9, no. 3, pp. 352–360, 2017, doi:10.20895/infotel.v9i3.288.
 - [13] Purjiyono, N. Astriawati, and PS Santosa, "Maintenance of the Main Engine Lubrication System on Km. Mutiara Sentosa II," *J. Teknovasi J. Tek. Dan Inov.*, vol. 6, no. 1, pp. 74–80, 2019.
 - [14] A. Nur, AS Ahmad, and M. Nur, "ATmega328PU AVR MICROCONTROLLER," *Maple*, vol. 4, no. 1, pp. 17–20, 2022.
 - [15] N. Azis, "Design encryption applications using caesar cipher and xor operation method," *Ikraith-Informatika*, vol. 2, no. 1, pp. 72–80, 2018.
 - [16] N. Hardyanti, M. Darmawan, and HS Huboyo, "Green Belt Design for Dust Pollution Control in Terboyo Industrial Area (Jalan Kaligawe)," *J. Ilmu Lingkung.*, vol. 19, no. 3, pp. 681–689, 2021, doi:10.14710/vol.19.3.681-689.
 - [17] BA Tanjung, M. Martias, and A. Andrizal, "The Effect of V-Belt Width on Fuel Consumption on Yamaha Mio Soul Motorcycles in 2011," *Automot. eng. ...*, vols. 3, no. 2, pp. 1–8, 2014, [Online]. Available: <http://ejournal.unp.ac.id/students/index.php/poto/article/view/915>.
 - [18] H. Mahmudi, "Analysis of Pulley and V-Belt Calculations in the Transmission System of a Counting Machine," *J. Nusan Machine.*, vol. 4, no. 1, pp. 40–46, 2021, doi:10.29407/jmn.v4i1.16201.