



ON BOARD DIAGNOSTIC FOR VEHICLE PREVENTIVE MAINTENANCE

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ABSTRACT

Preventive maintenance is one of other issues to maintain vehicle performance. Every vehicle needs a good handling when it is going to be worked on the road. Vehicle are consists of spare parts. Paying attention for the spare parts must be considered by every driver. Preventive maintenance is conducted to decrease costs as a results of used vehicle. When doing preventive maintenance, there are many types of works that should be known by a driver i.e.: checking parts, settlement, replacement, etc. In this study, distance kilometer and operational interval service in periodic level are being consideration to give information about vehicle preventive maintenance areas which is being showed it on board diagnostic warning on vehicle dashboard. In this study, the two parameters generally determine vehicle preventive maintenance diagnostic as the impact of them as long as a periodic time. Instrument process by using fuzzy design which can show us about stepping that should have to be done when it is working. When reading the information from on board diagnostic, the position of diagnostic instrument will show if it is the time for setting, checking or replacing of all parts. There are some conditions can be showed by instrumentation designing. Firstly, when the diagnostic position is showing null level can express that it is not being necessary to do anything for doing maintenance time. At the second, when diagnostic position is between at null level and one level the instrument can give the information needs to be checked at the areas of preventive maintenance including i.e. checked, settling and replacing of the spare parts to be maintained. The third, when the lamp shows us full level (one level), this instrument shows us to do breakdown vehicle maintenance. The diagnostic instrument is on the dashboard by using analog device for giving information about vehicle performance.

Keywords: Preventive maintenance, instrument, full level.

1. Introduction

Preventive maintenance is very important schedule to maintain vehicle from any damages in the future. There are a few level of preventive maintaining vehicle i.e. checked level, settling level and replacing level. Vehicle are consist of elements which support element to others. Generally, the purpose of vehicle maintenance are to keep vehicle remain steady well. The most important things is how to ride vehicle safely on the road without any disturbance will be happen in the future especially as a transportation for achieving economic growth. There are many activities which is categorized as maintenance procedure, i.e.: cleaning, checking and fastening elements, lubricating element, providing spare parts, light duties, heavy duties, and etc. Maintenance strategy and maintenance design need to reach its performance. Ability to lubricate elements, setting, repairing, and detecting from damages are wide scope for maintaining vehicle. Spooling-balancing is one solution for getting data about vehicle physical information. Problems like vibration, un-stability, handling will get soon after doing test. Settling process must be appropriate either rear wheel or front wheel. Settling time is used for keeping vehicle remain steady as affection of worn tire continuously. There are some symptom which make unstability ,i.e. passing highway in un-normal condition, giving vehicle load continuously without stopping. According to field experience checking for tire, checking for tie rod, end tie rod, ball joint, etc, and checking bushing and others will be priority ways for having knowledge about recent vehicle physical condition. Geometrical spooling-balancing will be listed by instrumentation and reported information prepares to fixing. Information about setting time will go on after checking time has been done clearly. Doing for spooling-balancing periodically, rotating tire correctly, following the direction of tire, checking for all of parts (steering, chassis, body, Air Conditioning, brake, electrical rig, engine, etc), doing spooling-balancing and brake caliper when it has been 10.000 km., giving grease on bearing until 20.000 km, avoiding from damage highway, avoiding from replacing tire with expired tire, etc will make vehicle performance keeping steady in the future.

2. Theory Background

Occasionally, preventive maintenance is focused to work by cleaning, inspection, small repair, and lubrication. Almost people divide level of maintenances i.e.: unplanned maintenance, planned maintenance, breakdown maintenance, preventive maintenance, corrective maintenance, running maintenance, and shutdown maintenance, etc. Further

information about level of maintenance is shown figure 1. Explanation about type maintenance gives an encouragement for conducting level of maintenance.

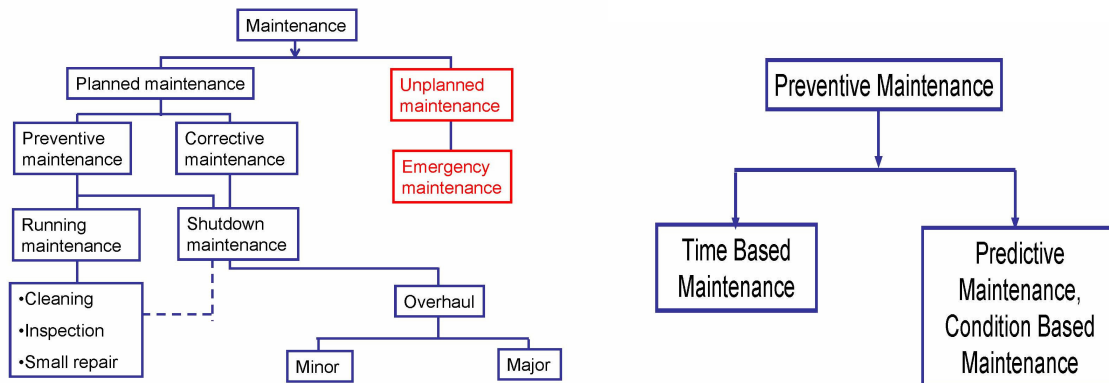


Figure 1. Classification of Maintenance and Preventive Maintenance

Preventive maintenance (PM) by itself is to keep performance that makes duration time will be longer. To maintain its performance versus time can be either explained as retarding time cycle. Without doing preventive maintenance cause time performance will be shorter than with preventive maintenance. It is mean that preventive maintenance makes components performance will decrease in incremental period time slowly.

Vehicle has been having fails when riding on highway because of some factors, i.e.: scuffing, galling, fretting, abrasion, fatigue, corrosion, erosion, aging, unwell lubrication, pollutant contamination, overheated, and miss-alignment, etc. Moreover, developing of conceptual maintenance is drawn in figure 2 below,

Strategy	<i>Reactive, Run To Failure</i>	<i>Preventive Maintenance</i>	<i>Predictive Maintenance</i>	<i>Proactive Maintenance</i>
Definition	Fix it when it breaks, Run to Failure	Conduct maintenance at regular intervals	Maintain based upon known condition/standard	Redesign to eliminate root cause of failure
Advantages (when implemented correctly)	Cheap	Can be planned for or scheduled	Can spot potential failure	Less maintenance required
Disadvantages (when implemented correctly)	High spare stock level. Emergency outages	Unnecessary replacement of parts. Poor utilization of labor.	Costly if implemented incorrectly	Could be expensive
Component you would maintain	Head light	Oil change	Automobile tires	2 year lease

Figure 2. Conceptual Maintenance

Arrangement of scheduling time for preventive maintenance is absolute very important to do for preparing replacing or settlement time of vehicle. According to the catalogue of vehicle, there are many different circumstances which has been supporting them that should be paid attention such as figure 3.



INTERVAL SERVIS: km	X 1,000		Interval servis Bulan atau Mil (Kilometer) Mana yang tercapai lebih dahulu																			
	5	30	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
STEERING																						
Oli manual steering gear	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kebocoran oli sistem power steering	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Minyak power steering	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	R	-	-	-	-	-
*Kelonggaran & kerusakan sistem power steering	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kelonggaran sambungan knuckle dan axle depan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mekanisme steering dari longgar dan rusak	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gerak main roda kemudi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fungsi steering	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheel alignment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Selang power steering	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-
REM																						
Minyak rem	-	-	-	R	-	-	-	R	-	-	-	-	R	-	-	-	R	-	-	-	-	R
Kebocoran minyak sistem rem	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
*Keausan tromol dan kampas rem	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Langkah dan gerak bebas pedal rem	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pipa & selang dari longgar dan rusak	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REM PARKIR																						
Kabel rem parkir	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fungsi rem parkir	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Langkah tuas rem parkir	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Keausan kampas rem	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Keausan dan kerusakan tromol rem	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Keausan dan kerusakan ratchet	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SUSPENSI																						
Kerusakan pegas daun	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kerusakan dan kekendoran mounting	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kebocoran shock absorber	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kekendoran mounting shock absorber	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KELISTRIKAN																						
Berat jenis air baterai	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RODA-RODA																						
Mur dan pin roda	-	-	-	T	-	-	-	-	T	-	-	-	T	-	-	-	T	-	-	-	T	-
Hub bearing grease	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	R	-	-	-	-	-
Tekanan ban dan kerusakannya	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LAIN-LAIN																						
Lampu, klakson dan wiper kaca	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baut & mur pada chassis dan body	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figure 3 Maintenance Schedule

Deciding the main research observe limitation of data are having level of vehicle distance from 0 – 100.000 km and service periodic level 0-48 months. However, limitation of data depends on type of vehicle and its performance. On this paper try to draw expectation of vehicle preventive maintenance which support figure 3 as a basic start for simplified research.

Generally, electrical body is rarely to check by driver because of minimal problems which is found. on above table have stated that not more and not less six months must be check condition including lighting lamp. Checking for fitting and wired joining should be accessed according to preventive maintenance schedule. There are some parts must be checked, settled, and replacing new parts when has been broken, i.e.: front fog lamp, parking lamps, front indicators, low beam lamps, side indicator, high beam lamps, etc. By adding preventive maintenance instrumentation should be checked to give information about faults correctly.



Figure 4 Vehicle Electrical Body

3. Research Methodology

Essentially, research progress which is displayed on this paper depends on steps for getting an accurate result, i.e.:

- Preparing for tools to support parameters. To support it by using Fuzzy Takagi-sugeno for starting the process for identifying involved parameter.
- Identify membership function of parameters to arrange level of confidence parameter for achieving target
 Distance Kilometer : $0 \leq \text{Distance_Kilometer} \leq 100.000 \text{ km}$
 Periodical Time : $0 \leq \text{Service_Periodical time} \leq 48 \text{ months}$
 Lamp position : $\text{OFF} \leq \text{WARNING} \leq \text{ON}$
- Finding the results of lamp position by giving rule editor.
 - Rule 1: If Distance Kilometer is low and length of periodical time is beginning then lamp position is off
 - Rule 2: If Distance Kilometer is medium and length of periodical time is middle then lamp position is warning
 - Rule 3 :If Distance Kilometer is high and length of periodical time is ending then lamp position is on
- Using servomotor to move solenoid-actuator based on distance instrumentation by setting variable position so that can be read lamp position below by ultrasonic sensor OFF, WARNING, and ON appropriate to on board diagnostic below at vehicle dashboard
- Lamp will be blaze when solenoid position has been reached ON position and is displayed at on board diagnostic.

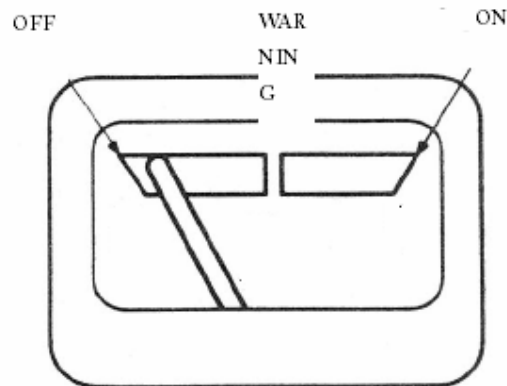


Figure 4 Reading of Lamp Position by Sensor and Full Level

4. Result and Discussion

Based on fuzzy design instrument, electronic control unit (ECU) will inform solenoid-actuator to do its works to fill up design completely which is appropriate to results:

Table I. Lamp Position for Preventive Maintenance Instrument

DISTANCE (Km)	LENGTH OF PERIODICAL SERVICE TIME (Month)				
	0	12	24	36	48
0	0.00	0.00	0.50	0.50	0.50
25	0.00	0.10	0.50	0.50	0.50
50	0.50	0.50	0.50	0.50	0.50
75	0.50	0.50	0.50	0.79	1.00
100	0.50	0.50	0.50	1.00	1.00

Based on diagram below, position lamp will be easy to read input which are consist of parameter, i.e: length of periodical service time and distance kilometer. The position lamp can be mapped to inform a driver about physical preventive maintenance and giving notes when should deliver vehicle to workshop for repairing and replacing by equipment tools.

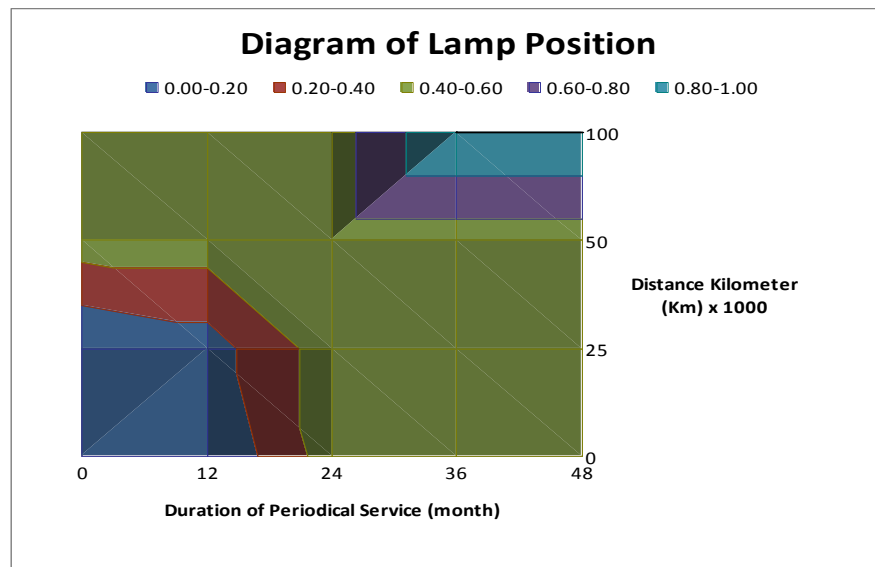


Figure 5 Lamp Position

If length of service periodical time is bigger and bigger without considering distance vehicle, the lamp position will give warning position to prepare for setting and replacing any parts that is having problem. Similar to distance kilometer is bigger and bigger without considering length of periodical time is giving warning position. But, If involving the two parameters will give the update condition about physical information about vehicle. If lamp position is above 0.5, the circumstance shows that vehicle should deliver to workshop for fast handling or damages will be happening.

5. Conclusion

Research shows that on board diagnostic of preventive maintenance is a tool to help driver for checking, setting, and replacing the element before having damages in the future. Instrument will decrease timing for servicing by following schedule time.

Fuzzy design helps us to identify parameter so that the result will be accurate and acceptable for doing validity. Fuzzy controller will also give information about physical condition of vehicle by showing the blaze lamp to remind driver for servicing vehicle.

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