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Experimental Study on Wheel Alignment of TATA Motors Heavy Commercial Vehicle

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Abstract: This paper represents the method of wheel alignment of heavy commercial vehicle. In particular subject of repair and eliminate the tire wear of vehicle and aligned the vehicle properly. The proper wheel alignment conducted on heavy duty vehicle with the help of computerized wheel alignment machine. As a result it was found that the tire life after repair was significantly improved. Therefore it was confirmed the feasibility of the proposed techniques as a useful repair method to improved tire life after wheel alignment.

Keywords: Alignment tools, Alignment bay, Alignment machine and sensor, HCV.

I. Introduction

The definition of wheel alignment can be defined as the process of measuring and adjusting the position of all wheels of vehicle which is attached to the chassis. The wheel alignment in heavy commercial vehicle is most effective method to reduce the tire wear and aligned the vehicle properly; it means directional control on vehicle.

The proposed wheel alignment system is used to perform the real time wheel alignment of vehicle. In order to maintain automobile performance, regular examination and adjustment of wheel alignment angles are needed by means of wheel alignment system. In this system the IR Sensors are used for wheel alignment, it has advantages of cost effective, superior than existing system, less time consuming. The proposed system can be implemented for almost all types of four wheelers where the wheel alignment is necessary. Furthermore, the proposed system can also use to find all types of misalignment by using only IR sensor.

Now-a-days 70% to 80% of heavy duty vehicle on the road are found misaligned. With the help of measuring the different angle of vehicle and angle adjusting we can improve the directional control on vehicle. The tire life and fuel performance or mileage is depending on each other in over the road transportation. The routine wheel alignment is the most effective way to control tire wear and tear. And can also impact on fuel performance of vehicle. The TATA MOTORS recommended the wheel alignment after an every 10,000 km as a part of average vehicle preventive maintenance program. Now write down below the some problem which is found due to misalignment of heavy duty vehicle.

The process of tire wear is very complex. Tire wear can effects on life of vehicles. It can be caused by a number of factors. Some of these include incorrect inflation, alignment issues, vehicle over-loading and worn out shocks and struts. In the conventional research, the tire wear is estimated by experiments. Otherwise, the tire wear is predicted by the tire vibration and model analysis.

1) An excessive tire wear can increased due to misalignment of vehicle.
2) The effect of misalignment of vehicle can indirectly impact on fuel performance. The increase fuel consumption caused by the increase rolling performance.
3) Due to the misalignment of vehicle the handling characteristics of vehicle get unsafe.
4) The misalignment of vehicle effect on directional control. So vehicle operator can lose the directional control on the vehicle.
5) Due to misalignment of vehicle the driver fatigue and driver retention can happened.
6) It cause premature suspension component wear in vehicle.

Now we can discuss on different angle which is use in the measuring and adjusting the position of all wheels.

A. Camber angle-

The camber angle is the defined as the angle between the centerline of the vehicle wheel which is viewed from the front and the vertical axis which is used for steering. [3]

When the centerline of the wheel inclined outward side then we can said that the angle is positive camber angle. And if the centerline is overlapped on the wheel and vertical axis then we can say it is zero camber angle. And also if the centerline of wheel inclines inward side then it is negative camber angle. The normally range of camber angle is between -1.5 to + 1.5

B. Caster Angle-

The caster angle is defined as the angle between the vertical axis and king pin centerline which is viewed from the side.[1] If the angle inclined in backward side then it is positive caster angle. And if the angle inclined frontward then it is negative caster angle. Normally the range of caster angle is -1 to 3.

C. Toe-

Toe is the comparison of a horizontal line drawn through both wheels of the same axle. When we observed from the top view on vehicle, if the distance between the front two wheels is smaller than the rear part of the two wheels then it is called toe-in.[3] Also when we viewed from top side the distance between front two wheels is larger than the rear part of the two wheels then it is toe-out. The toe-in and toe out can represent in the 'mm' or 'degree'.

D. Thrust angle-

The thrust angle is defined as the angled formed by the thrust line and geometric centerline. When the wheels of heavy duty vehicles are correctly positioned the vehicle can run steadily straight.[1] In case the real wheel are incorrectly positioned or set back is too big, the vehicle may be deviated. In heavy duty vehicle the moving direction is depend on vehicle centerline, geometric centerline and thrust line. The thrust angle generated due to incorrect rear angle position or the chassis may be damaged. In the rear wheels, the independent suspension system, the thrust angle also generated when there is unwanted toe-in adjustment for rear wheel. Due to of this the tire wear and tear rapidly increase in vehicle.

E. King Pin Inclination-

The king pin inclination is defined as the angle between vertical axis and king pin centerline. The range of king pin inclination is usually 6 to 9. [1] Also the sum of the king pin inclination and camber angle is called included angle. It makes the steering easier and tires more durable.

F. Turning Radius-

When vehicle operator making a turn, the steering angle of left front wheel and right front wheel are different, and to reached the preferable turning radius. The difference of the turning angle of the front wheels in a turn.[1] The angle difference between inner wheel and outer wheel is also called toe-out on turns or turning angle. The angle difference between inner wheels and outer wheels is around 2 to 4.

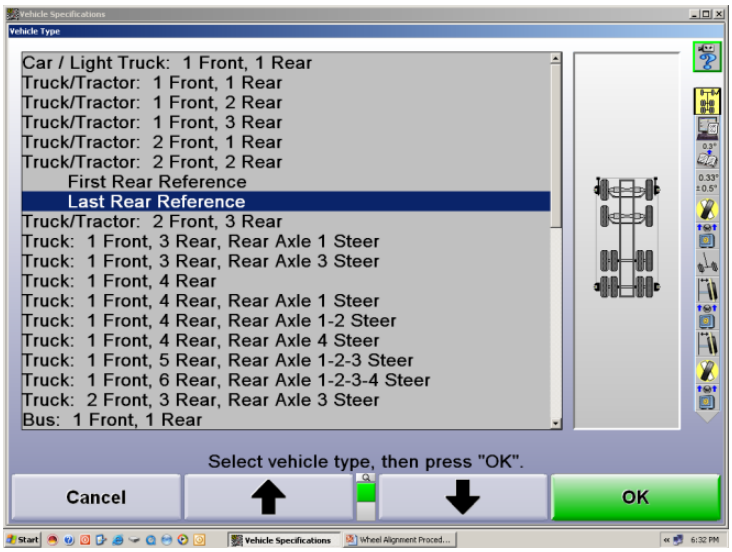
Pre-Checking Before Alignment-

1. First up all talk to vehicle operator & find out why he thinks the vehicle need an alignment.
2. Then take a vehicle trial and recognized the problem after that park the vehicle on alignment bay or track & inspect carefully check the tire condition. (tire wear & tear)
3. Checked the vehicle have recommended tire or not which & suggested by company.
4. Checked the air pressure in tire as per company recommendation the front tire have 140 PSI air pressure & the rear tire have 160 PSI (POUND PER SQUARE INCH).
5. Manually checked the tie rod, and checked boll joint, checked bushings, checked excessive play in tie rod in front or not.
6. Also checked steering play, king pin play & play on hub.
7. Checked the disk (wheel), in some case due to disk run out alignment get wrong on vehicle.
8. Checked a springs condition, U-clamp tight or loose & checking the bushing & suggest if any repairs are required in vehicle.

II. PROCEDURE

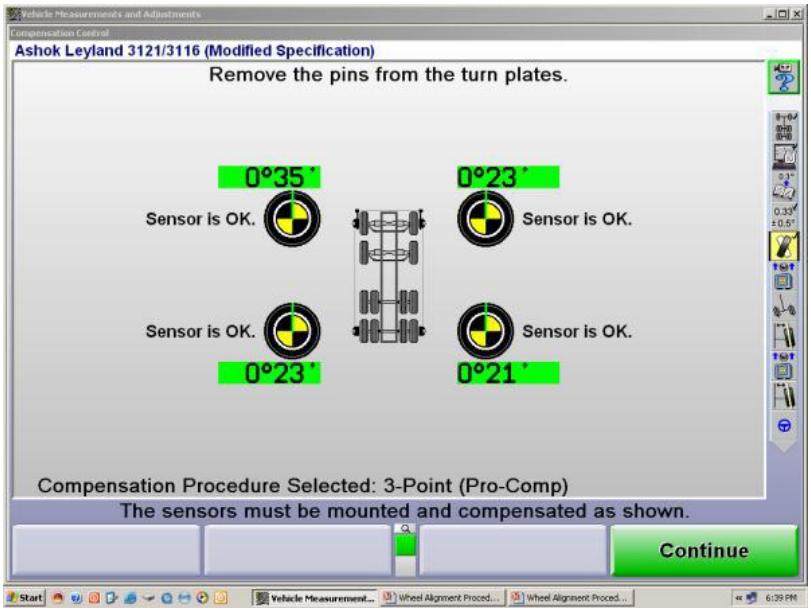
Park the vehicle on alignment bay, keep/park on turning table properly & apply brakes wheel chocks. When we start the machine the initial stage of the wheel alignment screen are show on computer screen. The click on "Start Begin" alignment on screen and then select vehicle model number. Here we choose the 2 front 2 rears axle vehicle after that feel the details information about vehicle & customer, then select the appropriate vehicle. We choose Tata motors 3118C vehicle for alignment and then click on "ok". The vehicle specification

for front axle is display on screen then the measure & enters the reference diameter from vehicle & click on next angle to get specification for lifting axle.



1. Select Vehicle Type

The sensors are mounted on vehicle disk. The four sensors are mounting on vehicle disk, 2 on front axle and 2 on rear axle. The lifted up the front two wheels with the help of air pressure jack. After that compensate the wheel disc with help of rotation & maintain the zero bottle setting, means set the tube level on sensor within range or in zero position. After that same procedure for rear axle, lifted up the rear axle with help of air pressure jack & compensation carried at on rear axle wheel. The reading for rear axle will be display on screen. Then click on 'save before measurements.' With the help vehicle operator steer ahead as directed by the computer program. When bar graph turns into green then click on ready.

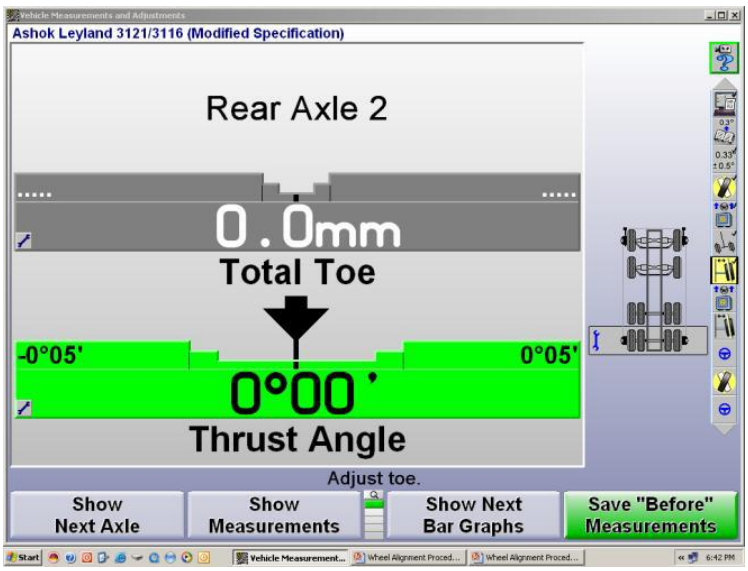


2. Sensor Compensation.

Then we can seen the thrust angle adjustment screen on display, the screen will show the adjustment in thrust angle with the help of spanner symbol. So loose the U-clamp of rear axle and adjust the thrust angle setting between rear axle & dummy axel.

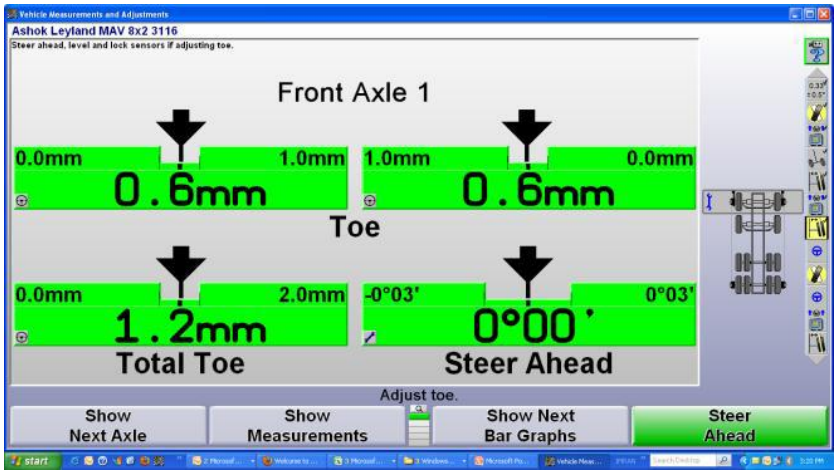
3. U-Clamp Tighten with Air Pressure Gun

The air pressure jacks are pushing the rear axle to forward direction & then tight the U-clamp & set thrust angle within proper range. The range of thrust angle is - 0.05 to 0.05 & we set angle in middle level in range. When the thrust angle bar graph turn into green so click on ok. Then click on 'save before management.'



4. Set Thrust Angle

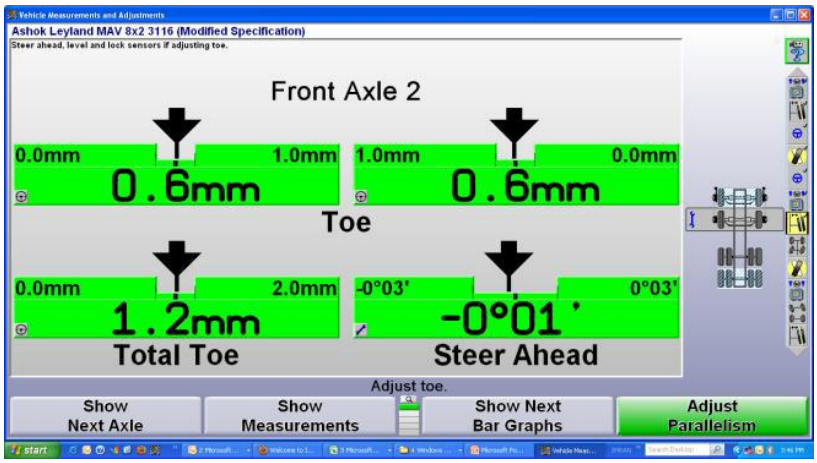
The readings for front axle will be displaced on screen. So the next step is measure the caster. The caster measurement completed by steering left, right and then steers ahead. After that front axle measurement will be display on screen. The display will show the bar graphs on screen. For set the tie rod within specification for that purpose loss the bolt of tie rod and then rotated the tie rod for adjust within specification. If tie rod are in require range then tight the bolt of tie rod by using tools & adjust left toe. Then used the front axle drag link to adjust right toe & steer ahead with specify range. The front axle, individual toe, total toe & steer ahead should be set within range. The specification range for toe in 0.00mm to 1.00mm, for total toe it will be 0.00mm to 2.00mm & for steer ahead the range will be -0.03 to 0.03. The steer ahead to "0" as directed on computer screen & clicked on press ready.



5. Front Axle Individual Toe, Total Toe and Steer Ahead set within specification.

Now shift the sensor from rear axle to lifting axel then did same procedure, which we carried at from front axle the compensated the sensor which in mount on lifting axel and set the tube level zero. After the sensor compensation click on continue then re-steer the steering as directed on computer screen & then press ready. The click on show next bar graphs until individual toe, total toe & steer ahead are displaced on screen. Then same procedure will carried out which we did for front axle toe setting. For the set the tie rod within range specification. loose the bolt of tie rod & then rotated the tie rod for adjust within range. When tie rod are in specify range then tight the bolt of tie rod by using tools and adjust left tie rod after that used the lifting axle

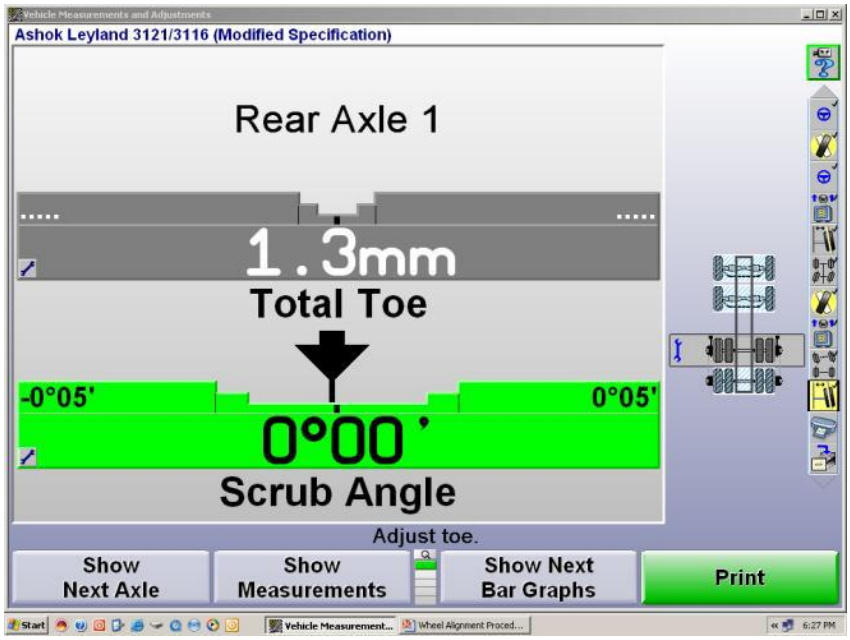
draglink to adjust right toe and steer ahead within specification. The computer screen will show the lifting axle individual toe, total toe, and steer ahead set within specification and the clicked on 'adjust parallelism.'



6. Lifting Axle 2 Individual Toe, Total Toe and Steer Ahead set within specifications

The Parallelism readings for lifting axle shown on displayed if the parallelism reading is not within the specification, then adjust the parallelism. The wheel alignment operator is adjusting the parallelism manually set it within specification. Then ensure that total toe & steer ahead for front axle within a specification range.

The next step for wheel alignment is now clicked on mount sensor to further procedure. Then shift the front axle sensor on rear axle & then mount the lifting axle sensor to dummy axel. Then compensate the all the four sensor and set the tube level on "zero". The clicked on continue after the sensors compensated are completed. Then the reading for rear axle displaced on computer screen. The click on save before measurement and then move to adjust the scrub angle. The scrub angle adjacent screen displaced on computer. The adjustment show on the screen with the help of spanner symbol. Then move the dummy axle to forward side with the help of hydraulic pressure jack and adjust the scrub angle within specification.



7. Set Scrub Angle

Then print out of the alignment report summery in hardcopy.

Stereopsis is the depth impression perceived when a scene is viewed by someone with two eyes and normal binocular vision. Analogous to human eyes which are laterally spaced on the head, stereo cameras

provide binocular vision that creates two slightly different images giving depth perception. Depth perception is obtained from a disparity map where disparity map is apparent difference between the pair of stereo images. [3]

$$Depth=\frac{focal\ length(mm)+baseline\ distance(mm)}{disparity(pixel)}$$

III. CONCLUSION

1. It was found that the proposed repair method greatly contributed to the increases the tire life and the reduction of the tire wear in vehicle. The effect on fuel performance, it means the mileage of vehicle can increases
2. The sufficient fuel performance can increase when the routine wheel alignment of the vehicle are conducted. And the average of vehicle can also increase.
3. The wheel alignment of heavy commercial vehicle was found to be effective to improve considerably and that sufficient effect after repair.
4. It was confirmed that generally the front axle tire give approximately 60,000km life and rear axle tire give 80,000km life: but if we take routine wheel alignment then we can increase tire life exceed to the 20,000km. It means front tire give 80,000km tire life and real tire life give 1lack km life.
5. The rotation and maintain recommended air pressure check after an every seven days can also increased the tire life of vehicle.

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