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Your Ref: TP/IP/25501/2020
Our Ref : CI/TPD20006671/D

31 August 2020

Fatal Accident Investigation Team
Traffic Police Department
Singapore Police Force
10 Ubi Avenue 3
Singapore 408865

Attn: SIO Adrian Lim

AUTOMOBILE TECHNICAL INSPECTION REPORT OF POLICE HEARSE YN 3128B

1. I refer to your request dated 24 June 2020 to comment on the cause of a part dislodging from the police hearse YN 3128B (herein referred to as "**PH**") on 10 June 2020 at about 1830hrs along PIE towards Tuas.

2. Briefly, the PH was travelling along PIE towards Tuas when one of the parts from the PH dislodged, flung onto the road and hit a motor car that was travelling on the right of the PH. The driver managed to control the PH and stopped along the road shoulder.

Physical Inspection of the Insured Vehicle

3. Following the request, the PH was physically inspected by me on 25 June 2020 at the premise of Indeco Engineering Pte Ltd, No. 39 Defu Lane 12, Singapore 539139. The mileage of the PH at the time of my inspection was 317,444km.

4. Generally, the PH was observed to be in a satisfactory condition with no loose exterior fittings observed.

5. The part that was dislodged from the PH was the rear section of the PH's propeller shaft. The propeller shaft of the PH connects the transmission (gearbox) at the front of the PH to the differential gearbox at the rear of the PH. The power from the transmission, rotates the propeller shaft, which in turn rotates the gears inside the differential gearbox, giving the drive to the wheels at the rear axle of the PH. Such system is commonly fitted on rear wheel drive vehicles and 4-wheel drive vehicles amongst others. The PH is a rear wheel drive vehicle.

6. Upon examination of the dislodged rear section propeller shaft, I had found it to be dented. From an original cylindrical shape, it was dented to a flatten shape with grazed/cut marks at multiple areas on the top and bottom sides. See photo 1 – 10 below.

Photo 1 shows the front right body of the PH. The PH was observed to be in a satisfactory condition with no loose exterior fittings observed. The mileage of the PH recorded at the time of my inspection was 317,444km.

Photo 2 shows a general view of the side body of the PH at the time of my inspection. The part that was dislodged from the PH was the rear section of the PH's propeller shaft, which was fitted at the underside of the PH. The location of this rear section, from a side view perspective, is indicated by the red arrow.

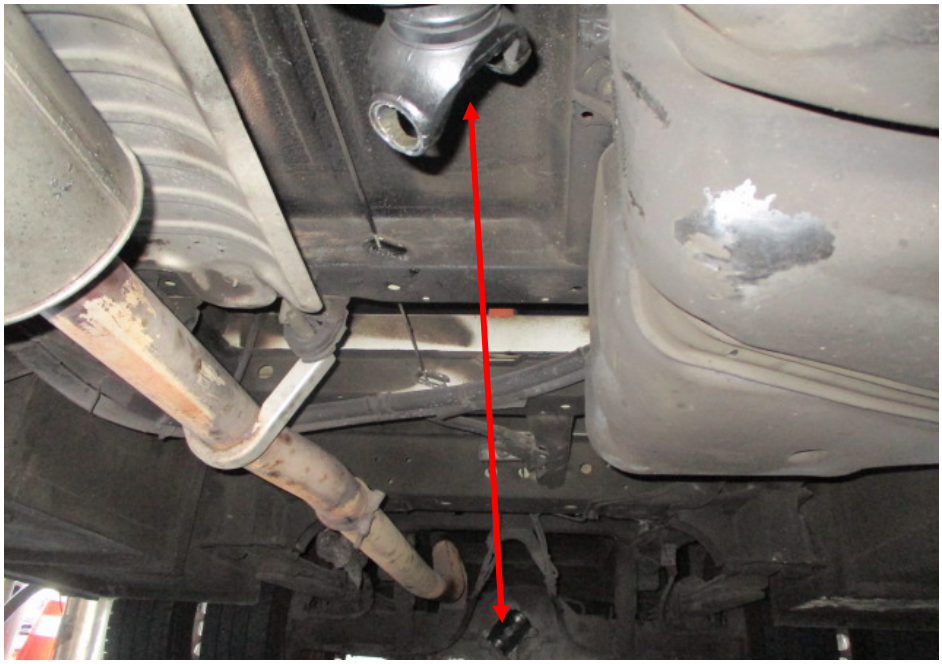

Photo 3 shows the underside of the PH. The part that was dislodged from the PH was the rear section of the PH's propeller shaft, which was fitted at the underside of the PH. The location of this rear section, from an underside view, is indicated by the red arrow.

Photo 4 shows the dislodged rear section of the PH's propeller shaft (arrowed). From an original cylindrical shape, the rear section was observed to be dented to a flatten shape with grazed/cut marks at multiple areas on the top and bottom sides.

Photo 5 shows a close up view of the grazed/cut marks at one end of the PH's propeller shaft rear section.

Photo 6 shows the propeller shaft rear section dented to a flatten shape from an original cylindrical shape.

Photo 7 shows the grazed/cut marks (circled) at another area of the PH's propeller shaft rear section. Grazed/cut marks were found on multiple areas on the top and bottom sides of the rear section.

Photo 8 shows the grazed/cut marks at another area on the bottom side of the propeller shaft rear section.

Photo 9 shows the grazed/cut marks at another area on the bottom side of the propeller shaft rear section. Generally, the dislodged rear section of the PH's propeller shaft, was observed to be dented. From an original cylindrical shape, it was dented to a flatten shape with grazed/cut marks at multiple areas on the top and bottom sides.

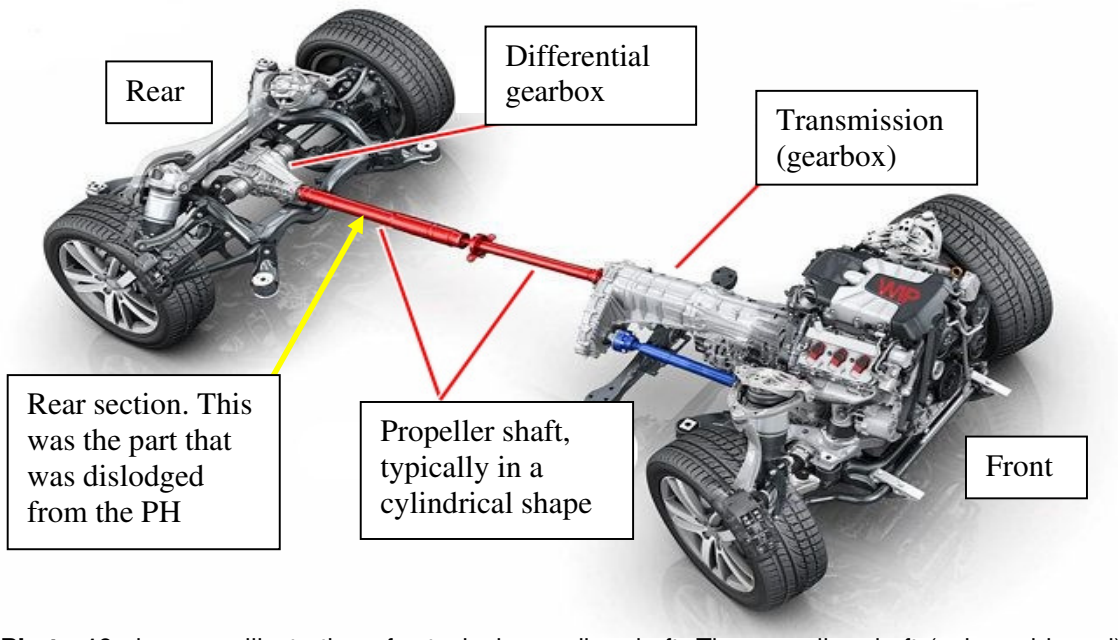

Photo 10 shows an illustration of a typical propeller shaft. The propeller shaft (coloured in red) connects the transmission (gearbox) at the front to the differential gearbox at the rear of a vehicle. The power from the transmission, rotates the propeller shaft, which in turn rotates the gears inside the differential gearbox, giving the drive to the wheels at the rear axle of a vehicle. As seen from the illustration, the propeller shaft is typically cylindrical shaped. The part that was dislodged from the PH is the propeller shaft rear section (highlighted by the yellow arrow).

Comments & Opinions

7. At the time of my inspection of the PH, I had managed to have sight of a new propeller shaft rear section that was purchased to replace the PH's damaged propeller shaft rear section.

8. A side by side comparison revealed that the universal joint (herein referred to as **"U" joint**) at the end of both sides of the PH's damaged propeller shaft rear section was missing. The "U" joint is used to secure/attach one end of the propeller shaft rear section to the propeller shaft front section and the other end to the input shaft of the differential gearbox. See photo 11 – 16 below.

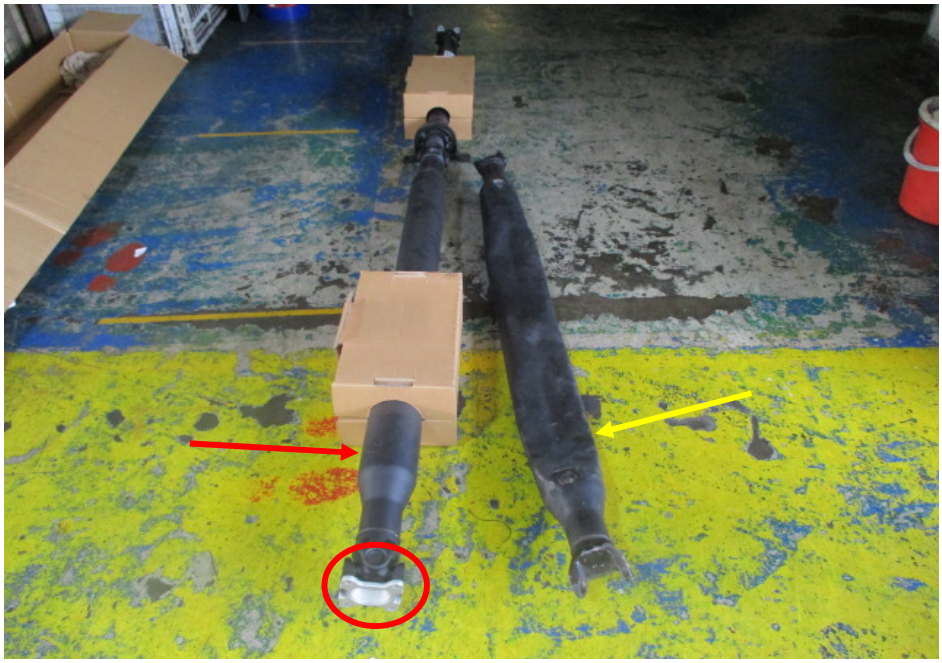

Photo 11 shows the PH's damaged propeller shaft rear section (yellow arrow) together with a new propeller shaft rear section (red arrow). Upon comparison, it was observed that the "U" joint at the end of both sides of the PH's damaged propeller shaft rear section was missing. The location of the "U" joint at one end of the propeller shaft rear section is highlighted by the red circle.

Photo 12 shows the "U" joint (arrowed) of a new propeller shaft rear section. The purpose of the "U" joint is for securing/attaching one end of the propeller shaft rear section to the propeller shaft front section and the other end to the input shaft of the differential gearbox. The "U" joint, shown in the photograph above, is for the end that is secured/attached to the input shaft of the differential gearbox. The "U" joint at the end of both sides of the PH's damaged propeller shaft rear section was missing. Refer to photograph 5, 7 & 9 above.

Photo 13 shows a closer view of the "U" joint (arrowed) of a new propeller shaft rear section. The purpose of the "U" joint is for securing/attaching one end of the propeller shaft rear section to the propeller shaft front section and the other end to the input shaft of the differential gearbox. The "U" joint at both ends of the PH's damaged propeller shaft rear section was missing.

Photo 14 shows the "U" joint (red arrow) of a new propeller shaft rear section. The "U" joint, shown in the photograph above, is for the end that secures/attach the propeller shaft rear section to the propeller shaft front section (yellow arrow). The "U" joint at the end of both sides of the PH's damaged propeller shaft rear section was missing. Refer to photograph 5, 7 & 9 above.

Photo 15 shows a closer view of the "U" joint (arrowed) of a new propeller shaft rear section. The "U' joint shown is for the end where the propeller shaft rear section is secured/attached to the propeller shaft front section. The purpose of the "U" joint is to secure/attach one end of the propeller shaft rear section to the propeller shaft front section and the other end to the input shaft of the differential gearbox. The "U" joint at the end of both sides of the PH's damaged propeller shaft rear section was missing. Refer to photograph 5, 7 & 9 above.

Photo 16 shows a typical "U" joint (arrowed) that is used for propeller shafts amongst other things.

9. Under normal circumstance when the PH is moving, the propeller shaft front section will rotate. The "U" joint, securing the front section to the propeller shaft rear section allows the rear section to rotate. Similarly, the "U" joint at the other end of the propeller shaft rear section, securing/attaching the rear section to the input shaft of the differential gearbox allows the gears in the differential gearbox to rotate, providing the drive to the rear axle.

10. During my examination of the PH's underside, I had checked on the differential gearbox, which is secured/attached to one end of the propeller shaft rear section. I had found the differential gearbox to be intact and undamaged. See photo 16 below.

11. The propeller shaft front section, which is secured/attached to the other end of the propeller shaft rear section was also still intact. I had found the front section relatively undamaged apart for its rubber bushing, which was broken due to the front section falling and resting on the support bracket when the propeller shaft rear section became dislodged. This rubber bushing was at the end of the propeller shaft front section that secures/attaches to the rear section via the "U" joint. See photo 17 - 19 below.

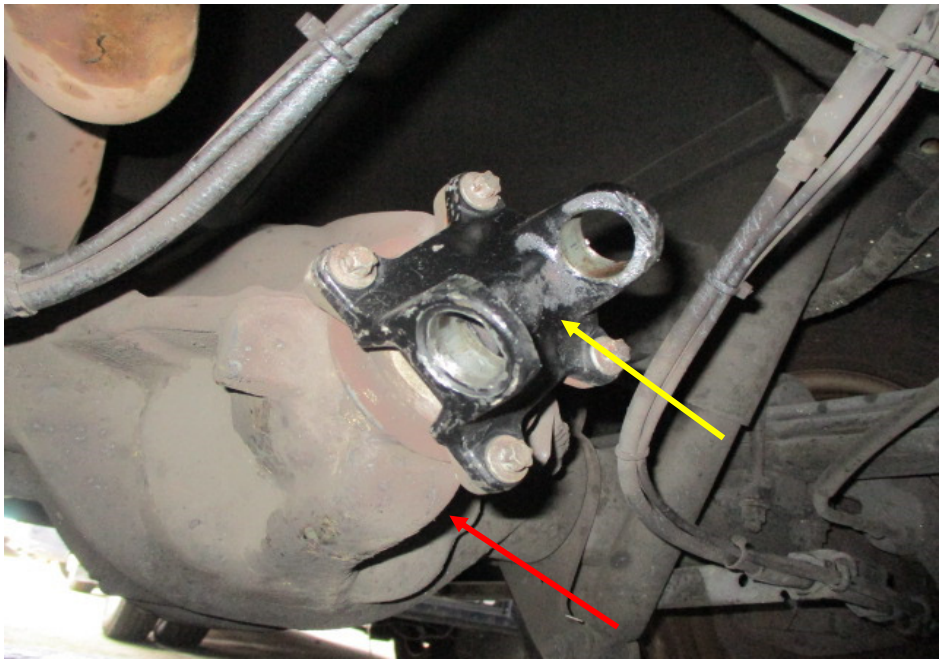

Photo 16 shows the differential gearbox (red arrow) of the PH, which was observed to be intact and undamaged. One end of the propeller shaft rear section is secured/attached to this differential gearbox at the location as highlighted by the yellow arrow via a "U" joint. As seen from the photograph, the "U" joint was missing.

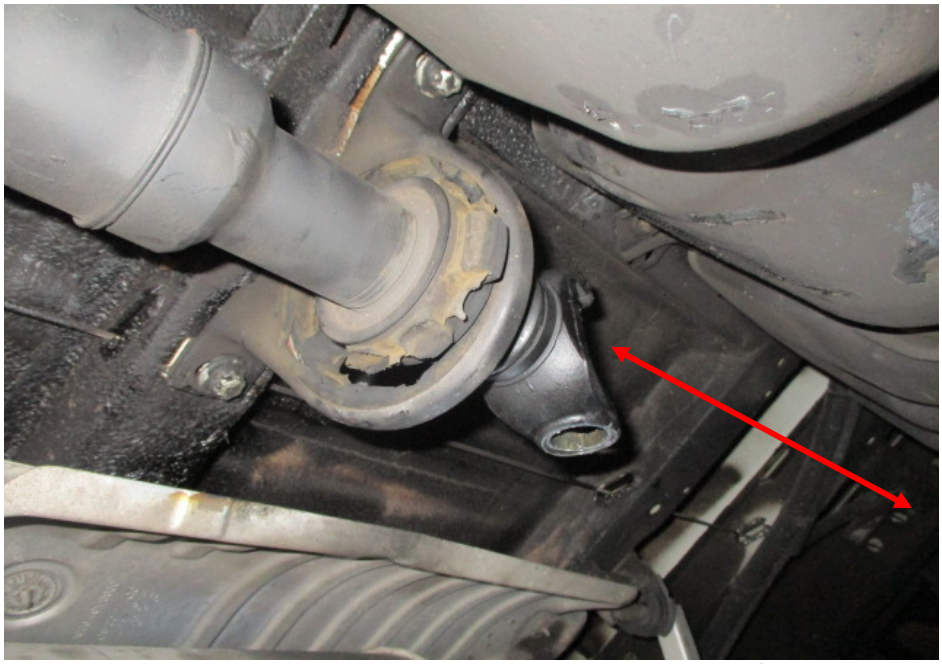

Photo 17 shows the propeller shaft front section of the PH. One end of the propeller shaft rear section is secured/attached to this front section via a "U" joint while the other end of the propeller shaft rear section is secured/attached to the differential gearbox as shown in photograph 16 above. The location where the propeller shaft rear section was supposed to be fitted is indicated by the red arrow. As seen from the photograph, the "U" joint was missing.

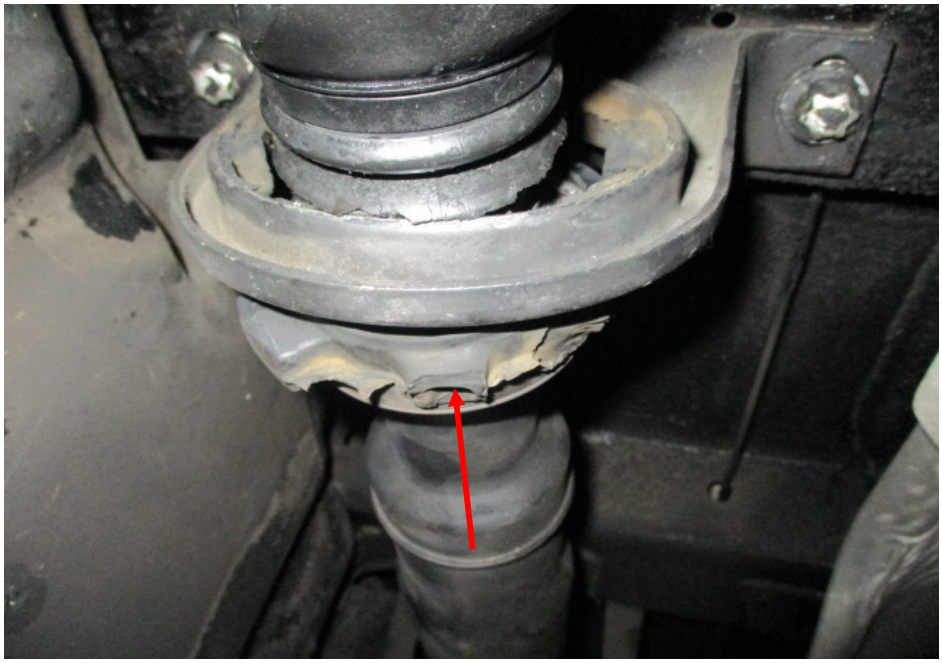

Photo 18 shows the propeller shaft front section of the PH at the time of my inspection. The rubber bushing (arrowed) of the propeller shaft front section was observed to be broken. This was due to the front section falling and resting on the support bracket when the propeller shaft rear section became detached. Other than this, the propeller shaft front section of the PH was observed to be relatively undamaged.

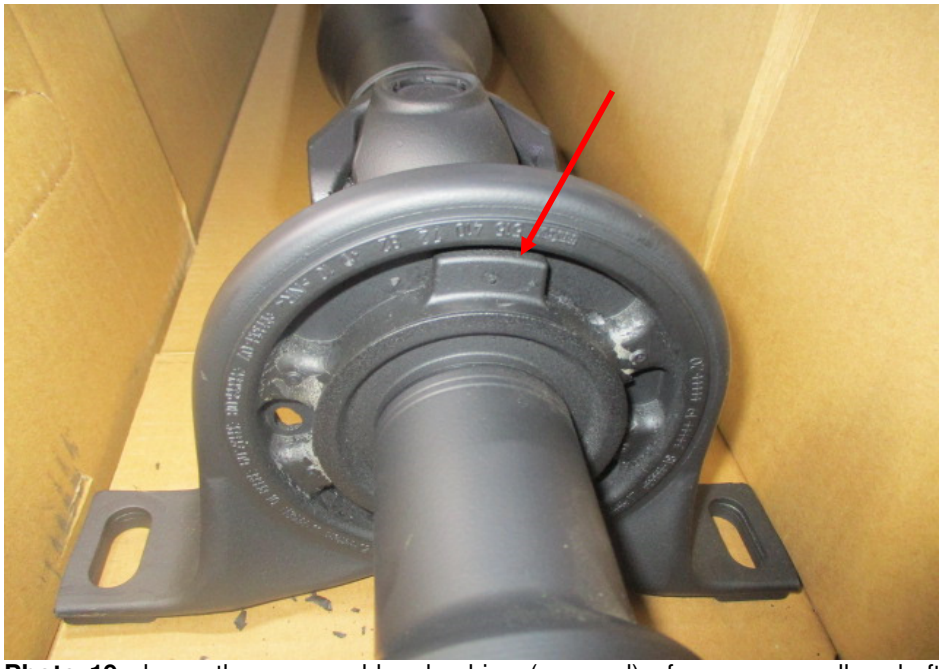

Photo 19 shows the same rubber bushing (arrowed) of a new propeller shaft front section for comparison purposes with the rubber bushing as seen in photograph 17 & 18 above.

12. The rubber bushing covers a set of bearings surrounding the propeller shaft front section. When tested manually, the bearings were able to rotate, indicating that the bearings were in serviceable/working condition. If the bearings were unable to rotate, this would cause a counter rotating reaction to the rotating propeller shaft of the PH during operation, which could lead to the propeller shaft rear section being detached from the propeller shaft front section. A video showing this manual test is attached together with this report.

13. Since the propeller shaft rear section is secured to the propeller shaft front section and to the differential gearbox by only a "U" joint at each of its end (without any other support bracket in between), the cause of the propeller shaft rear section detaching from the PH would, in all likelihood, be failure of one or both of its "U" joints. This is also taking into consideration that the propeller shaft front section and the differential gearbox of the PH was undamaged and still intact.

Conclusion

14. Based on the observations gathered during my inspection of the PH, which also included comparison with an undamaged propeller shaft rear section, it would appear to me that the dislodging of the PH's propeller shaft rear section was due to failure of one or both of its "U" joints.

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