



Auto
Consultants
Pte Ltd

Company Registration No. 199607198R

51 UBI AVE 1, #01-25 PAYA UBI INDUSTRIAL PARK, SINGAPORE 408933 TEL : (065) 62563561 FAX : (065) 67414108

Your Ref: S9M026Z1
Our Ref : CI/AXA20010912/D

28 August 2020

Damage Consistency Report of the Insured Motor Car SKF 5120S

**Requested By
AXA Insurance Pte Ltd
8 Shenton Way #24-01
AXA Tower
Singapore 068811**

Introduction & Background Information

1. I refer to your request dated 31 December 2019.
2. By way of introduction, I set out below a brief description of my professional qualifications and professional work experiences.
3. I am a Senior Technical Investigator and certified Accident Reconstructionist with LKK Auto Consultants Pte Ltd. I have been carrying out assessments, valuations, inspections and technical investigations of motor vehicles involved in, among other things, accidents since 2007. I have also carried out accident reconstruction basing on the laws of dynamics and physics by applying mathematical equations with technique competencies aligned with international standards, ensuring proper cause analysis. Some of my clients include the Singapore Police Force, NTUC Income Insurance Co-Operative Limited, AIG Asia Pacific Insurance Pte Ltd, AXA Insurance Singapore Pte Ltd, Cycle & Carriage Industries Pte Ltd and Performance Motors Limited amongst others. I also have experience in providing analysis and commentaries on damages and faults of motor vehicles.
4. I have given oral evidence as an expert witness in both the State Court and High Court, for both the prosecution and the defence for criminal proceedings and also for both the plaintiff and the defendant in civil proceedings. For instance, in MC Suit 17701/2010/Q, I acted as an expert witness in proceedings which involved among other things, a claim by an owner of a Mercedes sedan against the dealer for allegedly carrying out negligent works on the Mercedes sedan; in Suit 760/2011, I was asked by the dealer to provide my expert opinion on whether a brand new BMW sedan sold to a customer was defective. I have also been jointly appointed by both a car dealer and a car owner to provide my expert opinion as to whether the transmission of a brand-new car was defective.
5. My testimony as an expert witness for accident reconstruction and speed analysis cases involving criminal proceedings for the prosecution include amongst others, MAC 2350-51/2011, an accident involving four motor cars and a motorcycle resulting in the death of the motorcyclist; DAC 039421-2011, a motor car and motorcycle accident resulting in the death of the motorcyclist; MAC 3935/12, a motor lorry and pedal bicycle accident resulting in the death of the cyclist.

6. Cases where I have been engaged by an accused person include amongst others, DAC 60889-90/10, a motorcycle and motor car accident resulting in the death of the pillion rider; DAC 049130-2013 & DAC 049131-2013, self-accident involving a SMRT bus resulting in the death of one of its passengers.
7. I have also carried out numerous line of sight simulation, in close replication of an accident scenario, to determine a driver's view and sighting capability.
8. I hold a certificate in Technical Accident Investigation and Reconstruction from the Society of Automotive Engineers Australasia and a National ITE Certificate (Intermediate) in Automotive Technology (Light Vehicle) from the Institute of Technical Education. I have also attended training and passed a practical examination on correct repair methods, safe and cost-effective assessment of damaged motor vehicles (Thatcham Escribe System).
9. I am an affiliate member of the Society of Automotive Engineers Australasia; an affiliate member of the Institute of Automotive Engineer Assessors (UK); an associate member with the Society of Operations Engineers (UK).
10. For this report, I was requested to provide my opinions and comments on whether the damage sustained to the idler pulley and drive belt of the insured motor car SKF 5120S (herein referred to as "**Insured Vehicle**") was a result of the accident on 13 November 2019. The damage to the idler pulley had also led to damage to the engine block of the Insured Vehicle.
11. On 13 November 2019 at about 1255hrs, the Insured Vehicle was at the traffic junction of Upper Changi Road East and Expo Drive. After moving off from a stationary position, the Insured Vehicle collided into the rear portion of a motor vehicle that was in front. A report of the accident was subsequently made at Ah Lim Motor Company (Ang Mo Kio Autopoint) on 14 November 2019 at about 1316hrs for the purpose of an own damage claim.

12. On 18 November 2019, the Insured Vehicle was physically inspected by AXA Insurance Pte Ltd in-house surveyor at the premise of Alfred Auto Services & Supplies, Block 5035 Ang Mo Kio Industrial Park 2, where it was discovered that apart for the exterior frontal damage, the idler pulley of the Insured Vehicle was detached and the drive belt was torn. Alfred Auto Services & Supplies did not include the idler pulley and drive belt in the estimate cost of repair and there were also no further checks by them on the idler pulley and drive belt. They disagreed on AXA Insurance Pte Ltd parts costing, hence the owner of the Insured Vehicle decided to send the Insured Vehicle to Performance Motors Ltd, the local distributor for BMW make motor vehicles, for repair.
13. On 22 November 2019, another in-house surveyor of AXA Insurance Pte Ltd physically inspected the Insured Vehicle again and found similar extent of damage. I was thereafter requested to comment on whether the damage to the idler pulley and drive belt was related to this accident.

Documents Referred To & Methodology

14. The following were provided to me for consideration and analysis in the preparation of this report: -
 - a) Singapore Accident Statement lodged by the driver of the Insured Vehicle including photographs of the Insured Vehicle taken at the time of reporting;
 - b) Coloured photographs showing the damaged Insured Vehicle taken by the AXA Insurance Pte Ltd in-house surveyor on 18 November 2019;
 - c) Coloured photographs showing the damaged Insured Vehicle taken by the AXA Insurance Pte Ltd in-house surveyor on 22 November 2019;
 - d) Tax invoice AS19110004 from Autostrasse Pte Ltd dated 04 November 2019 for driver belt tensioner and drive belt replacement carried out to the Insured Vehicle.

15. For this case, I had carried out a physical inspection of the Insured Vehicle on 20 January 2020 and 21 January 2020 at the premises of Performance Motors Limited. The inspection carried out had involved dismantling of the exterior body parts at the frontal portion of the Insured Vehicle. The inspections were also carried out jointly with Koays Accident Reconstruction, the company appointed by the owner of the Insured Vehicle to carry out a technical analysis of the same matter. AXA in-house surveyors were also present during both inspections.
16. Prior to the 2 inspections on 20 January 2020 and 21 January 2020, I had initially carried out an inspection of the Insured Vehicle on 02 January 2020 at the premises of Performance Motors Limited. This was after receiving the request from AXA Insurance Pte Ltd. However, no further work was done pending agreement/arrangement for a joint inspection. For completeness, the condition of the Insured Vehicle on 02 January 2020 and on 20 January 2020 was the same, before dismantling work was done. Hence, in this report I will refer to the inspection on 20 January 2020 instead of 02 January 2020.
17. Observations and information gathered during my inspections were reviewed and analysed together with information gathered from my enquiries and researches carried out during the course of preparing this report.
18. My comments and opinions are now set out in the below paragraphs.

Damage to the Insured Vehicle

19. Exteriorly, the Insured Vehicle had sustained damage at its frontal portion. The front bumper, front grilles, front bonnet and front number plate were amongst the exterior body parts that were found to be with visible damage. The mileage of the Insured Vehicle was 100,218km. See photo 1 - 3 below.



Photo 1 shows a general view of the frontal portion of the Insured Vehicle at the time of the joint inspection on 20 January 2020.



Photo 2 shows a closer view of the frontal portion of the Insured Vehicle. The front bumper, front grilles, front bonnet and front number plate were amongst the exterior body parts that were found to be with visible damage.



Photo 3 shows another view of the frontal portion of the Insured Vehicle. The front bumper, front grilles, front bonnet and front number plate were amongst the exterior body parts that were found to be with visible damage.

20. The damage seen on the exterior of the Insured Vehicle is consistent to a front to rear collision where the front of the Insured Vehicle had collided into the rear portion of another motor vehicle.
21. At this inspection on 20 January 2020, I was also able to observe that the idler pulley was broken, and the drive belt torn/shredded. Both these damaged parts were already removed from the Insured Vehicle without any dismantling as both parts were no longer attached or fixed onto their original location given their physical damaged condition. See photo 4 - 6 below.
22. Parts at the frontal portion of the Insured Vehicle were subsequently dismantled in my presence. The dismantled parts had included the front bumper, front bumper reinforcement, front bumper sponge, front headlamps, front headlamps bracket and front support panel amongst others. All these parts were found to be damaged.
23. Without any dismantling, the Insured Vehicle's oil cooler, aircon condenser and radiator were also observed to be damaged. See photo 7 – 12 below.



Photo 4 shows the drive belt of the Insured Vehicle, which was observed to be torn/shredded.



Photo 5 shows the front side of the idler pulley of the Insured Vehicle. A section of the circumference edge was observed to be broken at both the front side and rear side (arrowed).



Photo 6 shows the rear side of the idler pulley of the Insured Vehicle. A section of the circumference edge was observed to be broken at both the front side and rear side (red arrow). The rear side of this idler pulley was mounted onto the engine housing of the Insured Vehicle and I had noted that a small part of the engine housing had chipped off (yellow arrow).



Photo 7 shows the Insured Vehicle during partial dismantling of the parts at its frontal portion on 20 January 2020. The front bumper reinforcement, radiator air guide and front support panel were amongst the parts (arrowed) that were found to be damaged.



Photo 8 shows the front bumper reinforcement of the Insured Vehicle, which was observed to be dented (circled) at the centre. The indentation was inwards of the Insured Vehicle.



Photo 9 shows the front left headlamp of the Insured Vehicle, which was found to be cracked/broken at the corner edge. When fitted on the Insured Vehicle, this corner edge is located slightly towards the left from the centre of the Insured Vehicle.



Photo 10 shows the front right headlamp of the Insured Vehicle, which was found to be cracked/broken at the corner edge. When fitted on the Insured Vehicle, this corner edge is located slightly towards the right from the centre of the Insured Vehicle.



Photo 11 shows the front support panel of the Insured Vehicle, which was observed to be broken (circled). When fitted on the Insured Vehicle, this broken area is located slightly towards the left from the centre of the Insured Vehicle.

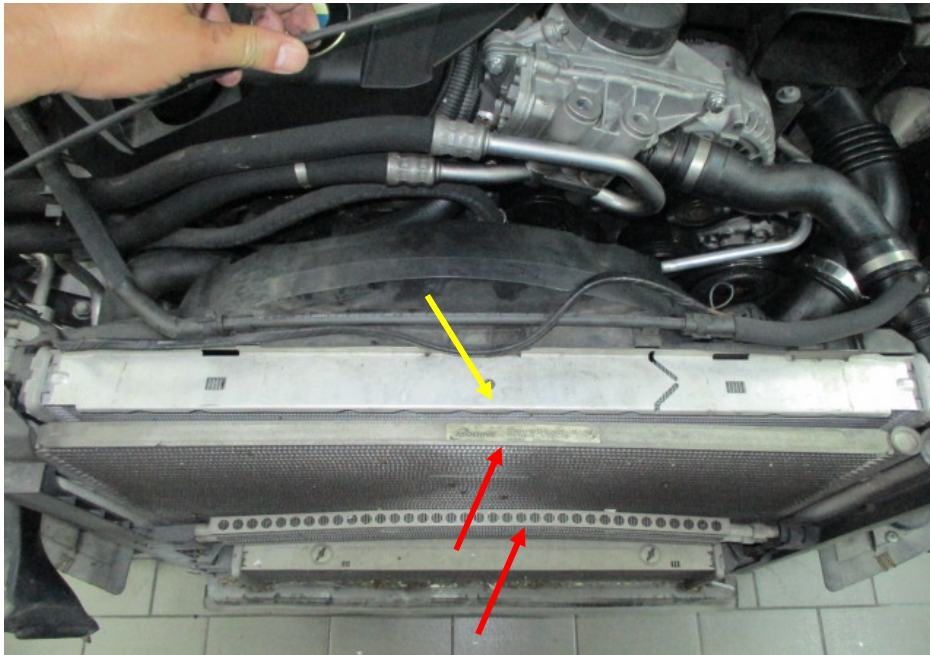


Photo 12 shows the oil cooler, aircon condenser and radiator of the Insured Vehicle. When still fitted on the Insured Vehicle, these parts were seen to bent inwards of the Insured Vehicle (red arrow). The bending of the radiator (yellow arrow) was less obvious as compared to the oil cooler and aircon condenser.

24. The Insured Vehicle was re-inspected on 21 January 2020 after its aircon condenser, radiator and radiator fan were dismantled and removed. This was to have sight of the location where the broken idler pulley was fitted.
25. It was observed that the engine housing where the idler pulley was mounted onto was broken/chipped off. See photo 13 & 14 below.



Photo 13 shows the Insured Vehicle during the re-inspection on 21 January 2020. The aircon condenser, radiator and radiator fan were dismantled and removed. The engine block of the Insured Vehicle, at the location where the idler pulley as mounted (arrowed), was observed to be broken/chipped off.

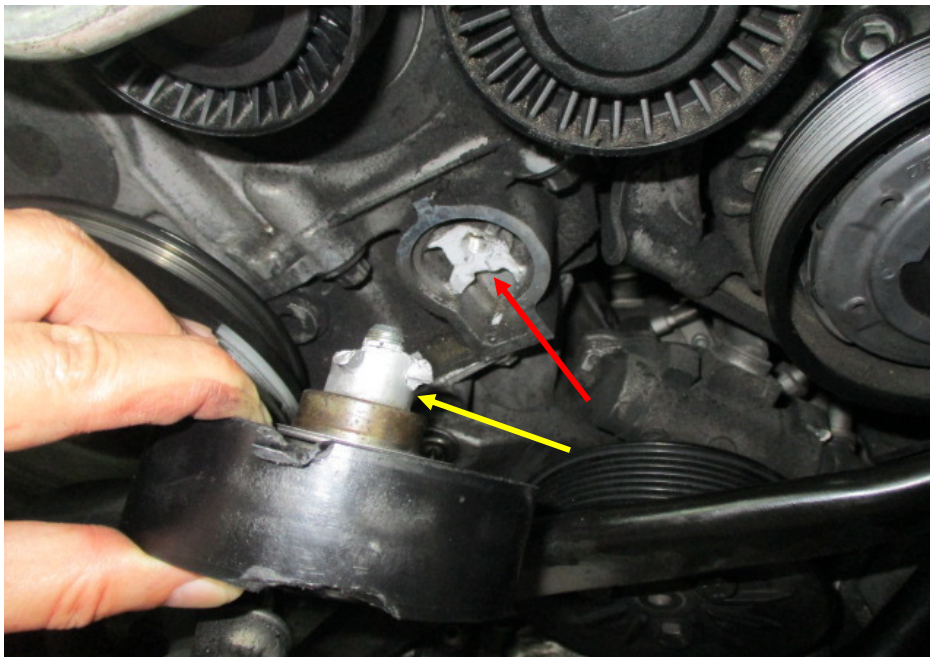


Photo 14 shows a closer view of the broken/chipped off engine block of the Insured Vehicle. The rear side of the idler pulley (yellow arrow) is mounted onto the broken/chipped of area (red arrow) of the engine block.

26. Upon checking the various pulleys and components, like the alternator, aircon compressor, water pump and power steering pump, that form the drive belt system of the Insured Vehicle, I had noted that the power steering pump had sunk downwards and was resting on the engine subframe of the Insured Vehicle whilst the other pulleys and components were still securely mounted onto their respective locations, less the idler pulley which was detached from its mounting location. Under normal circumstance, the drive belt of the Insured Vehicle that was found to be torn/shredded, wraps around these components allowing the respective motors to operate for these components to perform their respective functions.
27. My close examination of the power steering pump revealed that the cause of the power steering pump sinking downwards was due to inadequate support. The power steering pump should be secured in place by 3 bolts however only 1 bolt was found securing the power steering pump. For the remaining 2 bolts, 1 bolt was found to be sheared off while the other was found to be missing. See photo 15 – 18 below.

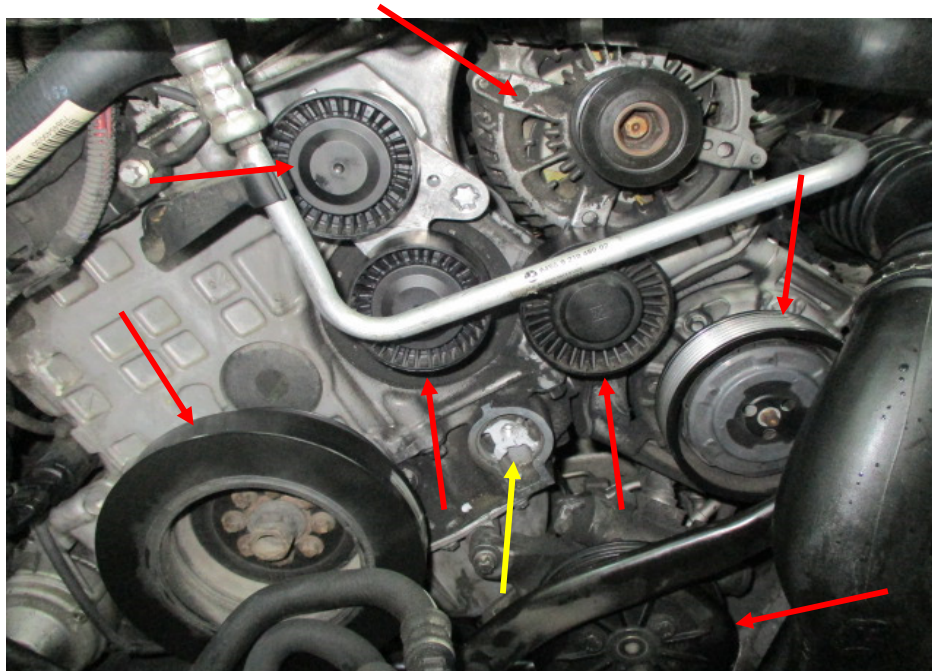


Photo 15 shows a general view of the various pulleys and components that form the drive belt system of the Insured Vehicle. These components include the alternator, aircon compressor, water pump and power steering pump amongst others. Under normal circumstance, the torn/shredded drive belt of the Insured Vehicle wraps around these components (red arrow) and the detached idler pulley (location highlighted by the yellow arrow).

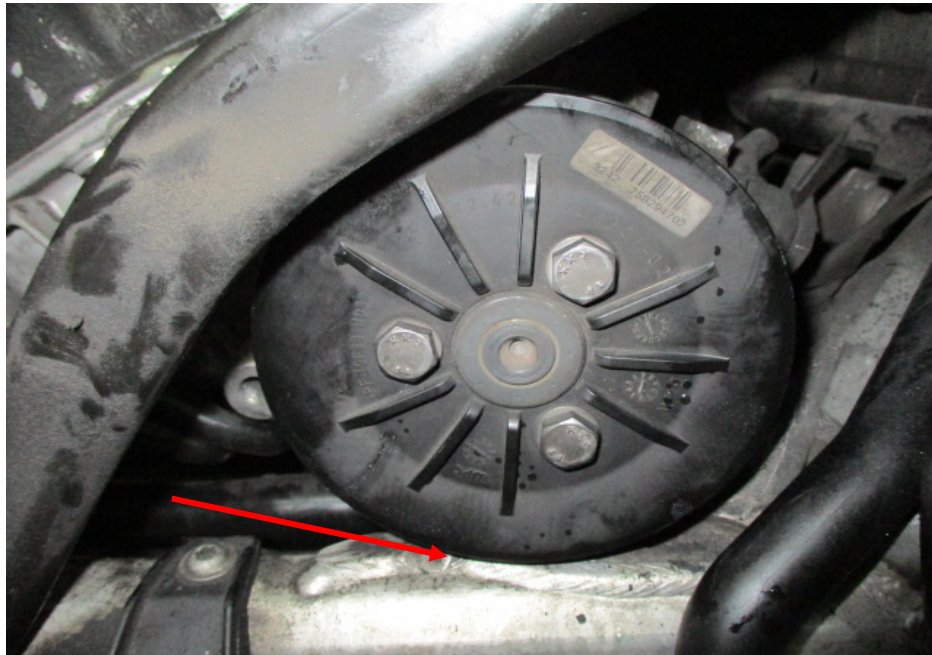


Photo 16 shows the power steering pump of the Insured Vehicle, which is located at the bottom of the drive belt system. Upon my examination of the power steering pump, I had noted that the bottom side (arrowed) of the power steering pump was resting on the engine cross member of the Insured Vehicle.

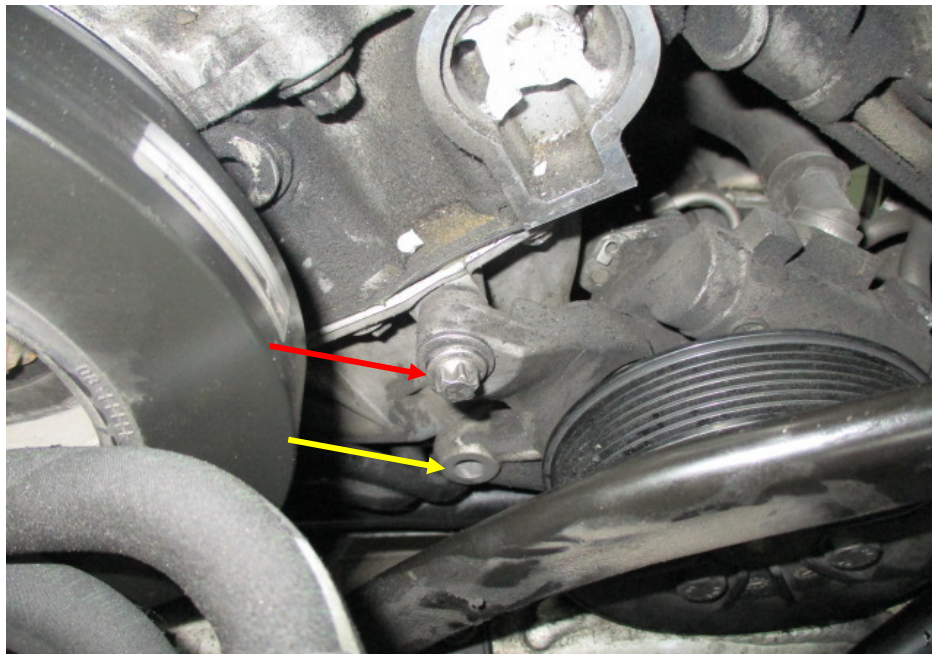


Photo 17 shows 2 of the 3 bolts that secures the power steering pump to its position. It was observed that the cause of the power steering pump sinking downwards was due to inadequate support. At the time of my inspection on 21 January 2020, the power steering pump was secured by only 1 bolt (red arrow). One bolt was observed to be missing (yellow arrow) while another bolt was observed to be sheared off (refer to photograph 18 below).

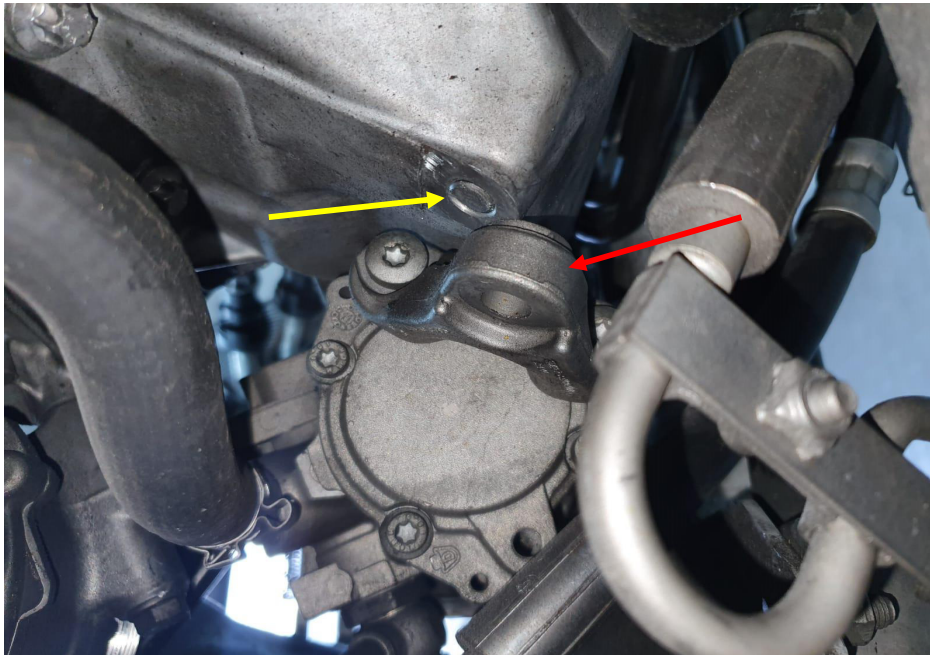


Photo 18 shows the sheared off bolt of the Insured Vehicle's power steering pump. This was located towards the bottom, at the back of the power steering pump (view from the bottom towards the top of the Insured Vehicle). Part of the sheared off bolt was still within the bolt hole at the mounting location (yellow arrow). The red arrow highlights the mounting location of the power steering pump where the sheared off bolt is supposed to hold the power steering pump in place. As seen from the photograph above, the power steering pump was shifted downwards from its original position.

Analysis, Comments & Opinions

28. Following the inspections of the Insured Vehicle that were carried out and my observations of the damage profile, the following paragraphs discusses the damage to the idler pulley, drive belt and engine block of the Insured Vehicle with respect to whether these parts were damaged from the accident on 13 November 2019.
29. In an accident collision, there will typically be 2 types of damage. One is commonly referred to as contact/direct damage while the other is referred to as induced/indirect damage. Contact/direct damage are parts damaged by direct contact with the impacting bodies (between vehicles/external objects); whereas induced/indirect damage are parts damaged by contact from some other part(s) of the same vehicle and/or by energy dissipation from a collision.

30. To further explain, the front bumper, front grilles, front bonnet of the Insured Vehicle are contact/direct damaged parts as these parts had come into direct contact with the vehicle that the Insured Vehicle had collided into. Parts like the front headlamps, front support panel, aircon condenser and radiator are induced/indirect damaged parts as these parts were damaged not from direct contact with the vehicle that the Insured Vehicle had collided into. These parts were damaged from Insured Vehicle's own parts being shifted/pushed inwards towards the rear of the Insured Vehicle during contact (maximum engagement) with the vehicle that the Insured Vehicle had collided into.
31. As for the idler pulley, drive belt and power steering pump, I note that these parts are located further inwards from the Insured Vehicle's frontal portion. In fact, as observed during my inspections of the Insured Vehicle, there is a gap/spacing between these parts and the parts that are link or attach to the frontal portion of the Insured Vehicle. See photo 19 below.

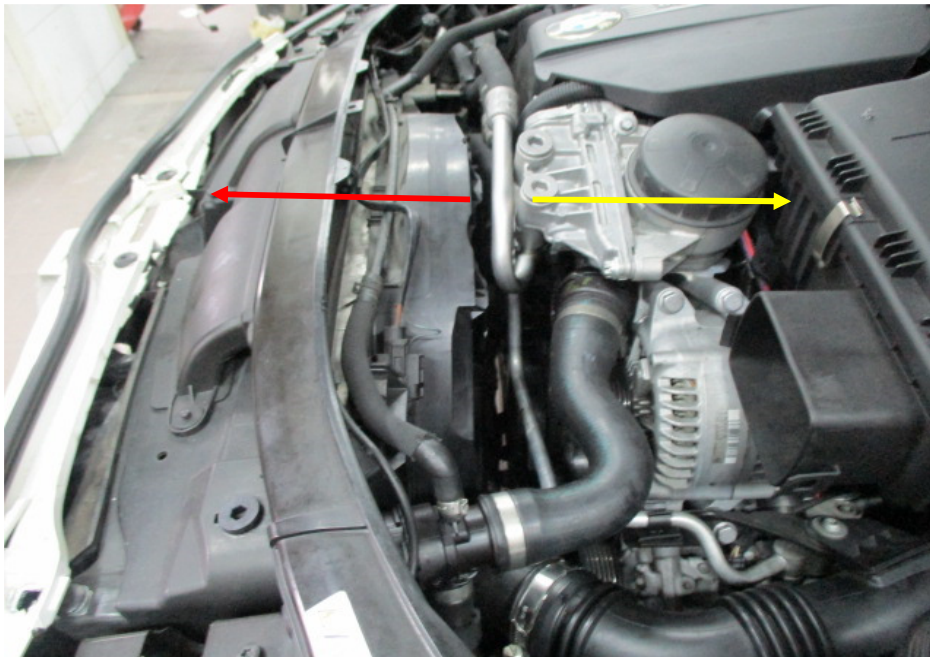


Photo 19 shows the side view perspective of the Insured Vehicle's engine compartment. The idler pulley, drive belt and power steering pump were located inwards of the Insured Vehicle's frontal portion (at approximately the start of the area highlighted by the yellow arrow). The idler pulley, drive belt and power steering pump are not link or attach to the parts at the frontal portion of the Insured Vehicle (highlighted by the red arrow area). In other words, there is a gap/spacing between the idler pulley, drive belt and power steering pump, and the parts link or attach to the frontal portion of the Insured Vehicle.

32. A gap/spacing typically allows for clearance so that the components of the drive belt system does not come into contact with any other part(s), which could lead to the drive belt being displaced, entangled etc during operation.
33. Given that there was a gap/spacing still present even after the accident, it can be reasonable to ascertain that the damage to the idler pulley, drive belt and power steering pump of the Insured Vehicle are not induced/indirect type of damage arising from the accident collision on 13 November 2019. In paragraph 29 above, induced/indirect damage occurs when body parts are damaged by contact from some other part(s) of the same vehicle.
34. In this case, the gap/spacing indicates that the idler pulley, drive belt and power steering pump did not come into contact with the parts located directly at their front, for example the radiator fan cowling, aircon pipe and support brace. If there was any contact, I would expect the radiator fan cowling, aircon pipe and support brace to be damaged and/or bent inwards and/or possibly to be still in contact with the idler pulley, drive belt and/or power steering pump. Damage due to energy dissipation is also not possible as the flow path of the energy is broken by the gap/spacing. See photo 20 below.



Photo 20 shows no contact between the drive belt system of the Insured vehicle and the parts directly in front.

35. The damage to the idler pulley, drive belt and power steering pump is also not a contact/direct type of damage as these parts are located inwards from the Insured Vehicle's frontal portion, and would not have been possible to come into direct contact with the vehicle that the Insured Vehicle had collided into.
36. Since the damage to the idler pulley, drive belt and power steering pump are not contact/direct type of damage and are also not induced/indirect type of damage, it would then appear to me that the damage to these parts are not related to the accident collision on 13 November 2019.
37. Earlier in paragraph 26, I had commented that the power steering pump of the Insured Vehicle was observed to have sunk downwards and in paragraph 27, I had commented that the power steering pump was supported by 3 bolts. One was still secured to the mounting point; one was sheared off and one was missing.
38. My observations of the bolt hole at the mounting point of the missing bolt appear to indicate the bolt was missing for a period of time. This was because the bolt hole was observed to be with dark dust accumulation. If the bolt was missing at or around the time of accident, I would expect the bolt hole to be clean or with slight light-coloured dust within the bolt hole. See photo 21 below.

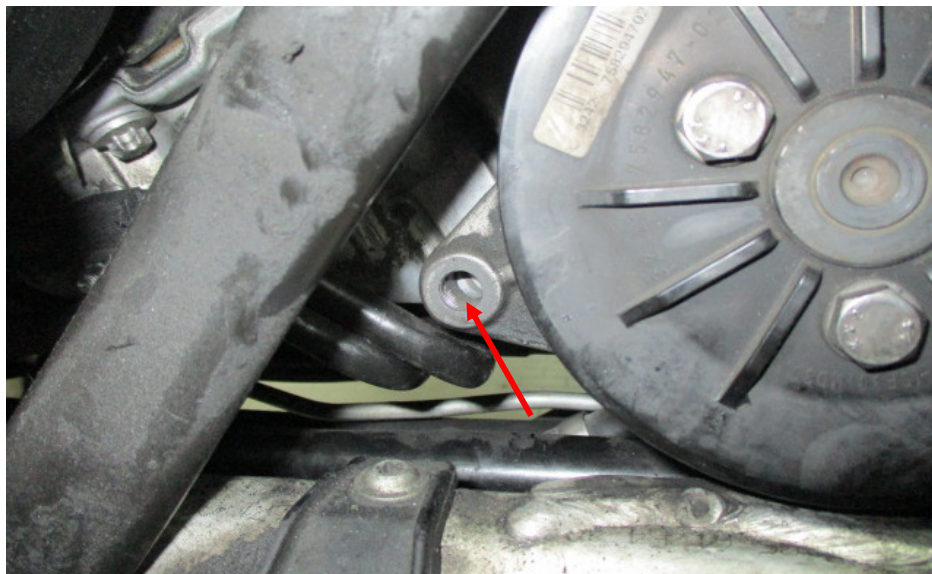


Photo 21 shows the dark dust accumulation (arrowed) that was observed within the bolt hole at the mounting point of the bolt that was observed to be missing. The presence of dark dust accumulation indicates that the bolt has been missing for a period of time.

39. Under normal circumstance, the power steering pump of the Insured Vehicle is supported by 3 bolts and given my observations it was, in all likelihood, supported by 2 bolts instead of 3 bolts for a period time. This gives additional material stress to the remaining 2 bolts and this material stress is magnified during engine operation when simultaneously, the drive belt system also operates. The inadequate support can cause the power steering pump to shake/vibrate, giving the additional material stress to the remaining 2 bolts to hold the power steering pump in place. This can compromise the material strength of the 2 remaining bolts.
40. The sheared off bolt of the power steering pump was a result of this material stress that the bolt was exposed to for a period of time and had eventually gave way. Such phenomenon is normally referred to as material failure or material fatigue.
41. In all likelihood, when the bolt sheared, the power steering pump sunk downwards, and this caused the drive belt to be stretched, displaced, entangled etc and eventually tear/shred. Similarly, the idler pulley was also pulled downwards by the sudden sinking downwards of the power steering pump, leading to it being detached or broken off from its mounting location and ultimately caused the engine housing to chip.
42. Energy dissipation from the collision could not have caused the missing bolt to become loose and subsequently dropped off when the Insured Vehicle was continued to be used after the accident. This is because damage by energy dissipation from the collision was not possible as the flow path of the energy is broken by the gap/spacing (paragraph 34 above). Simply put, it was not possible for the missing bolt to be affected by the impact forces arising from the accident. The same reason would apply to the sheared off bolt where the impact forces would not cause the material strength of the bolt to be compromised.
43. Furthermore, energy dissipation diminishes as it flows further away from the point of impact as parts/components surrounding the point of impact absorb the energy, giving rise to physical damage. For this case, the physical damage to the radiator was lesser as compared to the oil cooler and aircon condenser (refer to photograph 12 above). This was because the radiator was exposed to lesser energy dissipation due to the oil cooler, aircon condenser and other parts at the front of the Insured Vehicle absorbing significant amount of energy and therefore as the energy flows further away from the point of impact, it becomes weaker.

44. The idler pulley, drive belt and power steering pump and its bolts were all remotely located behind the radiator fan with a gap/spacing in between. Even if consideration was given that the energy had managed to flow to the location where these components were located, I would expect the energy to be significantly weakened as compared to the energy at the point of impact. Note that even the radiator fan of the Insured Vehicle, which was attached to the radiator and in front of the idler pulley, drive belt and power steering pump, was found with no damage caused by the accident. Simply put, it would not be possible for parts at the front to be undamaged and parts behind to be affected.

Conclusion

45. Having considered the observations and information that I was able to gather from my inspections of the Insured Vehicle, as well as from the material information gathered from the documents that were provided to me in preparation of this report, I am of the opinion that the damage to the idler pulley, drive belt and engine housing are not related to the accident on 13 November 2019.
46. The damage was purely a result of material failure/fatigue to a bolt supporting the power steering pump of the Insured Vehicle that arose from inadequate support to the power steering pump caused by a bolt that was missing not due to the accident on 13 November 2019.



Ang Bryan Tani

Senior Technical Investigator

Technical Investigation & Accident Reconstructionist (SAE-A)

DISCLAIMER OF LIABILITY TO THIRD PARTIES:- This Report is made solely for the use and benefit of the Client named on the front page of this Report. No liability or responsibility whatsoever, in contract or tort, is accepted to any third party who may rely on the Report wholly or in part. Any third party acting or relying on this Report, in whole or in part, does so at his or her own risk.