LKK 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: IA2018-37264 7 May 2018
Our Ref : CI/IAS18009114/N

M/s Insight Adjusters and Surveyors Pte. Ltd.
133 Cecil Street
#14-02
Keck Seng Tower
Singapore 069535

TECHNICAL INVESTIGATION REPORT OF ENGINE DAMAGE TO THE INSURED VEHICLE SKR 1163G

1. We refer to your request dated 3 May 2018 to conduct an investigation and analysis to determine the cause of damage to the engine of the insured vehicle SKR 1163G (herein referred to as **"Insured Vehicle"**).

2. The following documents/data were provided to us in preparation of this report:-

   a) Singapore Accident Statement of the driver of the Insured Vehicle, where amongst other information, the circumstance of incident was described;

   b) 116 coloured photographs showing the damage to the Insured Vehicle;

   c) Invoice Number 28954 from Rong Seng Auto dated 26 January 2018, reflecting the details of the latest vehicle maintenance work carried out to the Insured Vehicle;

   d) Invoice Number 28995 from Rong Seng Auto dated 4 May 2018, reflecting the details of the parts purchased for the engine damage repair work carried out to the Insured Vehicle.

Reported Incident

3. On 25 April 2018 the driver of the Insured Vehicle, Mr Roy Tay (herein referred to as **"Mr Tay"**) had sent his son to Jurong after which he noticed that the illumination of the 'Check Engine' warning light. He then drove to SAFRA Jurong located at 333 Boon Lay Way. He took a snapshot of it and sent it to the owner of Rong Seng Auto (herein referred to as **"RSA"**) which is the workshop he sends the Insured Vehicle for periodic servicing. The owner told him not to drive and instead tow the Insured Vehicle to RSA.

4. Mr Tay then called the Automobile Association of Singapore (herein referred to as **"AA"**) and was directed to the towing personnel cum technician of Autoswift Recovery Pte. Ltd. who came down to inspect the Insured Vehicle. The technician made superficial checks on the Insured Vehicle such the engine oil and radiator coolant levels which were normal. When the Insured Vehicle was started up again the 'Check Engine' warning light was still illuminating. The technician did not inform Mr Tay to call for a tow truck. Hence Mr Tay continued to drive the Insured Vehicle to RSA. As he was travelling along Clementi Avenue 6 the Insured Vehicle broke down due to overheating. Mr Tay then called the AA again and had the Insured Vehicle towed to RSA.

5. In preparation of this report, we had conducted a physical inspection of the Insured Vehicle.

Inspection of the Insured Vehicle

6. We inspected the Insured Vehicle on 2 May 2018 at the premises of Rong Seng Auto (herein referred to as **"RSA"**) located at 2 Kaki Bukit Avenue 2, #01-21, Autohub @ Kaki Bukit Singapore 417921. We now set out below our observations and comments with respect to our inspection.

7. The following general vehicle information was first recorded at the time of our inspection: -

Registration Number	: SKR 1163G
Chassis Number	: MR053ZEE106106986
Speedo Reading	: N.A. (battery disconnected)

8. The Insured Vehicle was observed to be in good general condition with no visible damage to the exterior body. We did however observe that the engine had been dismounted from the engine bay and dismantled. The various components of the Insured Vehicle's coolant system had also been removed from the front portion of the engine compartment.

9. Upon examination of the dismantled engine components of the Insured Vehicle, we had found damages to the engine inlet manifold, engine block cylinder heads, engine valves, engine valve seals, pistons and piston rings.

10. Upon further examination, we had found the engine inlet manifold, engine block cylinder heads, engine valves and engine valve seals to be partially burnt and/or melted. The pistons and piston rings were observed to be severely burnt and cracked. There were also scoring marks on the sides of the burnt pistons. Scoring marks were also found on the cylinder walls of the engine block.

11. Causation of such scoring marks is due to the pistons which are made of aluminium heating up faster than the engine block. Due to the overheating of the engine, the pistons will expand radically as they get hot, which is not the case for the cylinders of the engine block. The pistons will bind against the cylinder walls thus badly scoring those walls, burning and cracking the pistons as well as the piston rings. This will cause the pistons and eventually the engine of the Insured Vehicle to seize. The damage profile of these parts corresponds to the Insured Vehicle overheating. See photos 1 – 8 below.

Photo 1 shows the general view of the Insured Vehicle being hoisted for checks on its undercarriage at the time of our inspection. The Insured Vehicle was observed to be in good general condition with no visible damage to the exterior body.

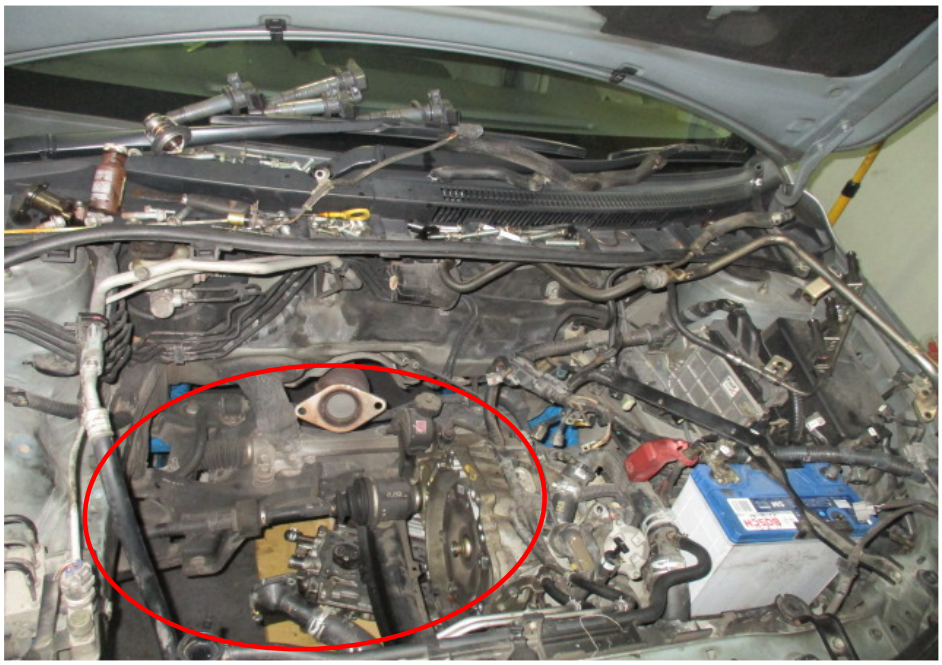


Photo 2 shows the general view of the engine compartment of the Insured Vehicle at the time of our inspection. We observed that the engine had been dismounted from the engine bay and dismantled. The various components of the Insured Vehicle's cooling system had also been removed from the front portion of the engine compartment (circled).

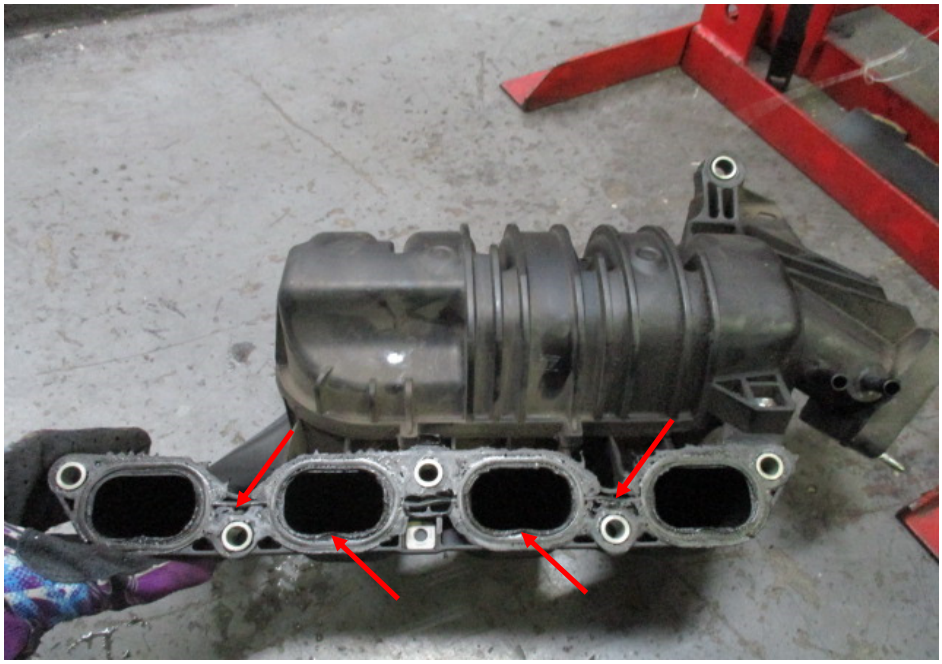


Photo 3 shows the engine inlet manifold of the Insured Vehicle which was observed to be partially burnt and/or melted (arrowed).

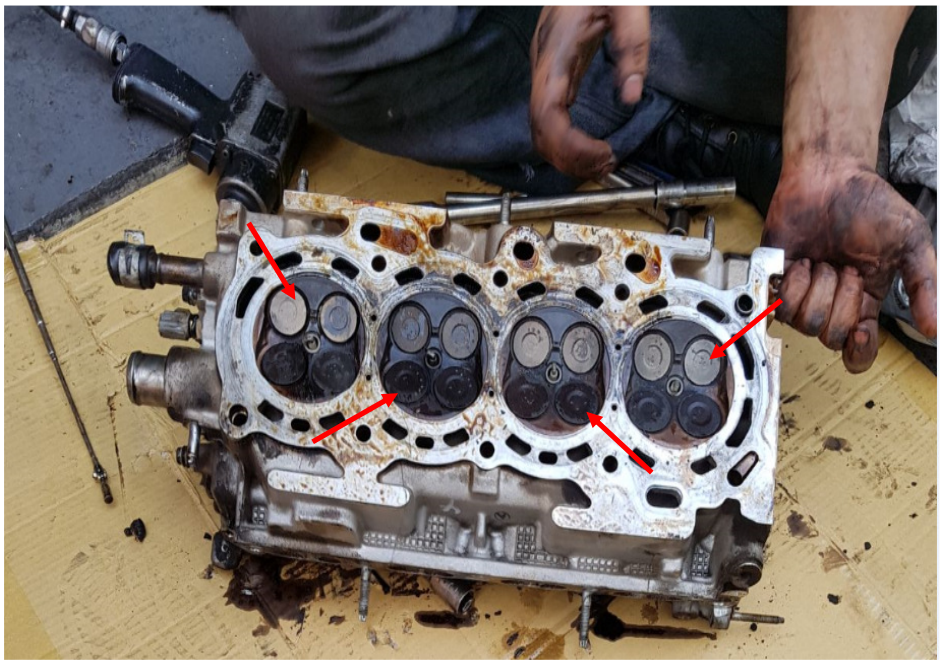


Photo 4 shows the engine valves and engine valve seals of the Insured Vehicle which were observed to be partially burnt and/or melted (arrowed).

Photo 5 shows the pistons of the Insured Vehicle which were observed to be severely burnt.

Photo 6 shows the cracked piston rings on the severely burnt pistons of the Insured Vehicle (circled).

Photo 7 shows the scoring marks observed on the sides of 1 of the severely burnt pistons (arrowed). Causation of such scoring marks is due to the pistons which are made of aluminium heating up faster than the engine block. Due to the overheating of the engine, the pistons will expand radically as they get hot, which is not the case for the cylinders of the engine block. The pistons will bind against the cylinder walls thus badly scoring those walls, burning and cracking the pistons as well as the piston rings.

Photo 8 shows the scoring marks observed on the cylinder walls of the engine block (arrowed). Causation of such scoring marks is due to the pistons which are made of aluminium heating up faster than the engine block. Due to the overheating of the engine, the pistons will expand radically as they get hot, which is not the case for the cylinders of the engine block. The pistons will bind against the cylinder walls thus badly scoring those walls.

12. We had also found damages to the dismantled components of the Insured Vehicle's cooling system. These had included the radiator, radiator outlet joint, radiator hoses, water pump and thermostat. Upon further examination, we had found the radiator and thermostat to partially burnt and/or melted. The radiator outlet joint and radiator hoses were broken. The cooling system is designed to maintain ideal engine operating temperature as tremendous heat is produced while the engine is in operation. See photos 9 – 13 below.

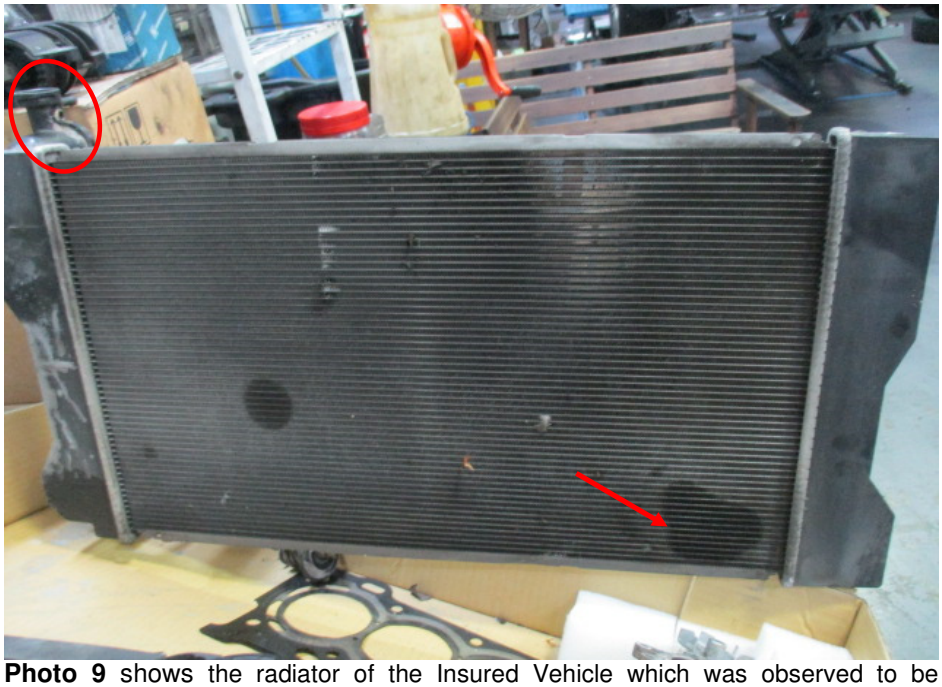


Photo 9 shows the radiator of the Insured Vehicle which was observed to be partially burnt and/or melted (arrowed) and the broken radiator outlet joint (circled).

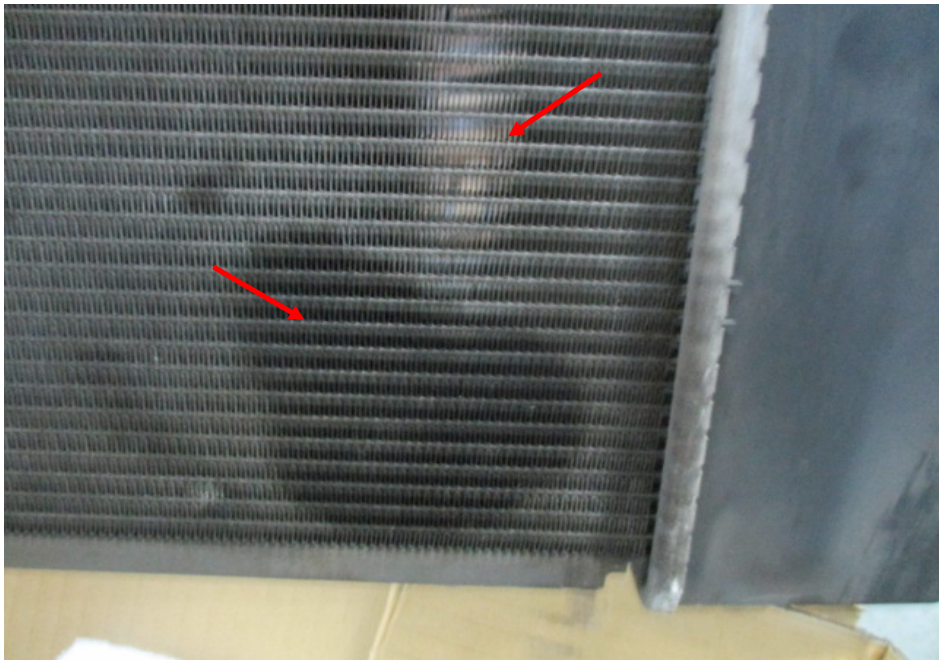


Photo 10 shows a close up view of the radiator of the Insured Vehicle which was observed to be partially burnt and/or melted (arrowed).

Photo 11 shows a close up view of the broken radiator outlet joint (circled).

Photo 12 shows a close up view of the Insured Vehicle's thermostat which was observed to be partially burnt and/or melted.

Photo 13 shows the broken radiator hose caused by overheating of the Insured Vehicle (circled).

Comments & Opinions

13. For this case, the damage profile of the Insured Vehicle's engine and cooling system components corresponds to the Insured Vehicle overheating causing the engine to cease. Under normal operation circumstances, a vehicle's engine will not overheat. Overheating of a vehicles' engine can be due to several factors, such as insufficient engine oil and/or radiator coolant, leaking radiator, faulty cooling fans, worn radiator hoses, water pump or thermostat which are necessary components that need to be in good working order to ensure that a vehicle does not overheat.

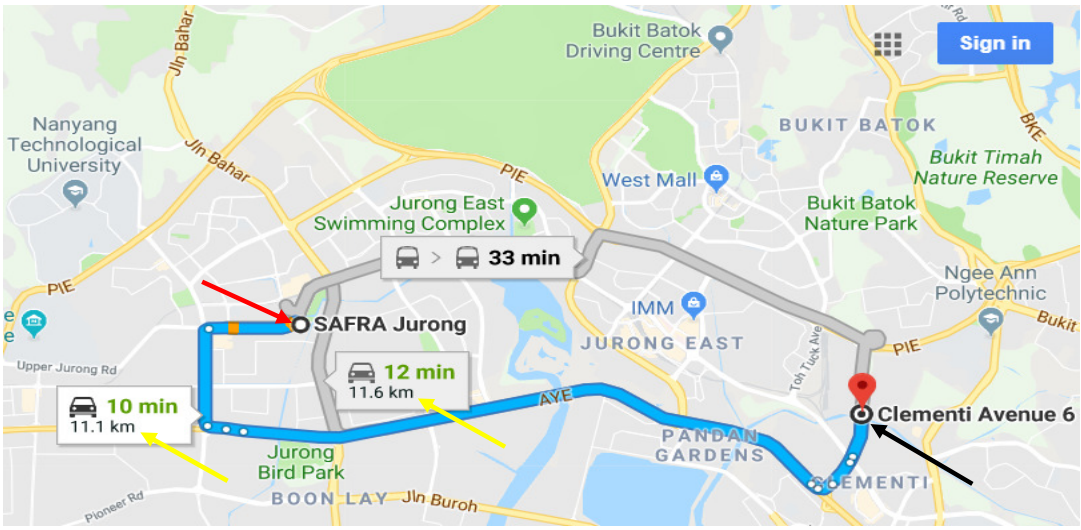
14. Given the circumstances of incident as reported, the possibility of the cause of engine overheating to the Insured Vehicle being due to insufficient coolant would seem unlikely as the coolant level was sufficient when checked by the AA technician prior to the incident.

15. During our physical inspection of the Insured Vehicle we did not observe any leakage of engine oil from the engine oil sump. There were also no signs of physical damage to the engine oil sump. Hence the possibility of the cause of engine overheating being due to engine oil leakage would seem unlikely.

16. The possibility of the cause of engine overheating to the Insured Vehicle being due to a coolant system malfunction (worn out coolant system components and/or coolant leakage) would then seem more likely given that insufficient coolant and leakage of engine oil would both seem unlikely. The engine overheating due to a coolant system malfunction is also supported by the condition of the components of Insured Vehicle's coolant system which was earlier discussed in paragraph 12 above.

17. However in such engine overheating type of incidents, the engine of the vehicle will not be affected by the vehicle overheating, provided that there was no further operation of the engine and/or continued driving of the Insured Vehicle.

18. For this case, the Insured Vehicle was driven from SAFRA Jurong to RSA where it broke down along Clementi Avenue 6. Basing on Google Map, the approximate distance from SAFRA Jurong to the reported location where the Insured Vehicle broke down along Clementi Avenue 6 (where it was towed) was approximately between 11.1km to 11.6km. See screenshot extracted from Google Map below.



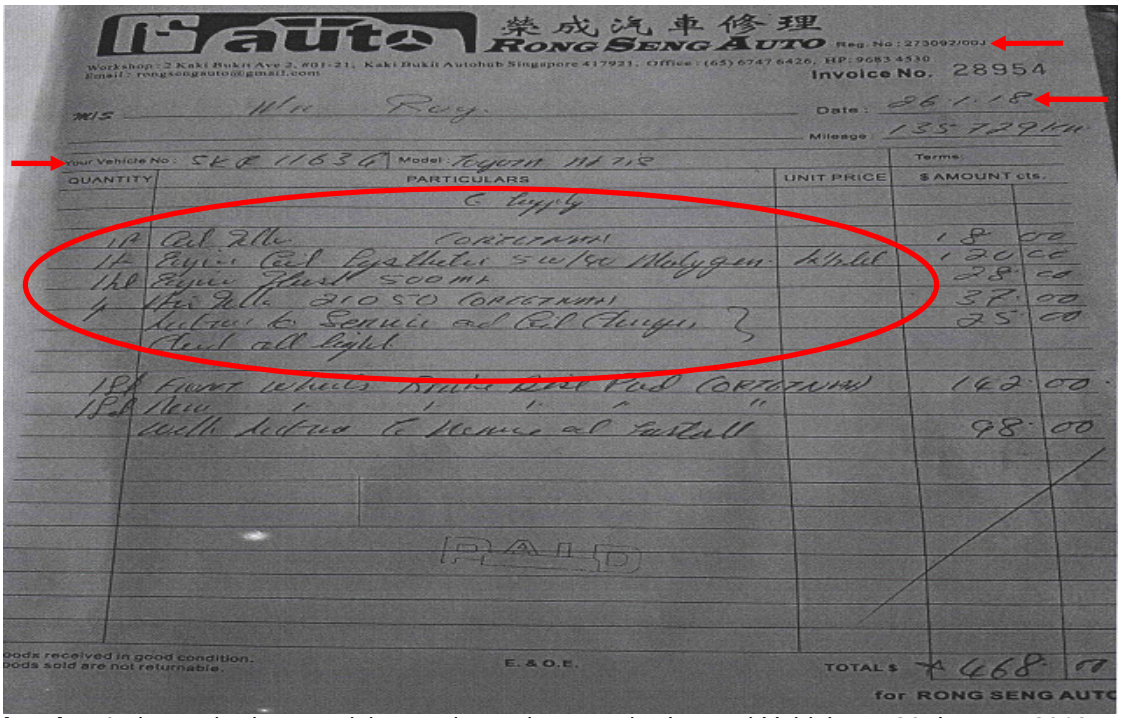
Screenshot extracted from Google Map shows the shortest distance where the Insured Vehicle would have been driven from SAFRA Jurong (red arrow) to Clementi Avenue 6 (black arrow) which was approximately between 11.1km to 11.6km (yellow arrows). Co-relating this distance with this particular case, the Insured Vehicle had travelled a distance of at least 11.1km before it broke down.

19. As a result of driving, the temperature in the engine would have thus significantly increased due to the coolant system malfunction when the Insured Vehicle was being driven to RSA.

20. This would have then led to overheating of the engine components, ultimately affecting and burning the mechanical parts inside the engine in particular the pistons. Hence, resulting in the pistons seizing which eventually caused the engine of the Insured Vehicle to stop operating.

21. The damage to the engine of the Insured Vehicle could have thus been avoided if it was not driven for this 11.1km. Such damage can therefore be considered to be a consequential damage as a result of the Insured Vehicle being driven.

22. During the course of our investigations, we were able to obtain from RSA the latest servicing and repair records of the Insured Vehicle. The last servicing was done on 26 January 2018.The servicing package included changing of engine oil and oil filter. The front and rear brakes were checked and serviced. All fluid levels were also checked. Refer to Invoice 1 below.


榮成汽車修理
RONG SENG AUTO
Invoice No. 28954
Date: 26/1/18
Mileage 135729km
Your Vehicle No: SKB 1163G
QUANTITY | PARTICULARS | UNIT PRICE | $ AMOUNT cts.
Goods received in good condition. Goods sold are not returnable.
E. & O.E.
TOTAL $ 468 00
for RONG SENG AUTO

Invoice 1 shows the last servicing package done on the Insured Vehicle on 26 January 2018 at RSA (arrowed) which included changing of engine oil and oil filter. The front and rear brake pads were replaced. All fluid levels were also checked (circled).

23. We were also able to obtain from RSA the tax invoice dated 4 May 2018 for the engine repair to the Insured Vehicle post- incident. The repair had included the damaged parts from both the engine and cooling system of the Insured Vehicle. However it had also included parts of the coolant system which were unlikely to be damaged due to overheating of the Insured Vehicle such as the water pump, fan belt and belt tensioner. Refer to Invoice 2 below.

RS auto 榮成汽車修理 RONG SENG AUTO Reg. No : 273092/00J
Workshop : 2 Kaki Bukit Ave 2, #01-21, Kaki Bukit Autohub Singapore 417921, Office : (65) 6747 6426, HP: 9683 4530
Email : rongsengauto@gmail.com
Invoice No. 28995
M/S Roy Tay Date: 4.5.18
KR 1163 G

	Supply.		
1Pc	Oil filter	18.	00
4Ltr	Engine Oil Synthetic 5W/40 Liqui Moly Molibden	120	00
4Ltr	Automatic Oil WS	75.	
1Set	Overhaul Gasket Kit Complete	228.	5
1Pc	Water Pump Assy.	107.	95
1Pc	Fan Belt	39.	
1Pc	Belt Tensioner Assy.	105.	
4pcs	Spark plug Denso	20.	
4pcs	Piston Assy.	260.	00
1Set	Piston Rings	107.	90
1Pc	Sensor Knock	150.	22.
1Pc	Radiator Assy.	285.	00.
1Pc	Thermostat Ring	28.	60
4Ltr	Radiator Coolant (Shell)	45.	00
1Pc	Inlet Manifold Assy.	288.	
1Pc	Sensor	83.	46
1Pc	4pcs Mounting	156.	00
1Pc	Radiator Hose outlet Joint	45.	50
1Pc	Engine Gasket Sealing Gum	37.	7
		2202.	

PAID

Authorised Signature

Invoice 2 shows the engine repair done to the Insured Vehicle post- incident by RSA (circled). The repair had included the damaged parts from both the engine and cooling system of the Insured Vehicle (red arrows). However it had also included parts of the cooling system which were unlikely to be damaged due to overheating of the Insured Vehicle such as the water pump, fan belt and belt tensioner (black arrows).

24. Although many components in the engine as well as coolant system of the Insured Vehicle were damaged as a result of the Insured Vehicle overheating, the damage to the water pump, fan belt and belt tensioner were most likely to be caused by wear and tear and not due to overheating of the engine. See the table below.

Engine and coolant components damaged from overheating	**Engine and coolant components damaged from wear and tear**
Pistons	Water pump
Piston rings	Fan belt
Radiator	Belt tensioner
Radiator outlet joint	
Thermostat	
Inlet manifold	

Conclusion

25. Having carried out a review and analysis of the material evidence, we are of the opinion that the damage to the engine of the Insured Vehicle was due to overheating of the engine most likely due to a malfunction of the coolant system which is necessary for maintaining regular engine operating temperature and heat removal purposes. The increased temperature caused the mechanical parts (pistons) to expand, resulting in direct contact/grazing between the pistons and the engine block cylinder walls. Overheating in the engine caused the pistons to burn and crack, eventually seizing and causing the engine to stop operating.

26. Our investigations revealed that the Insured Vehicle was driven for approximately 11.1km before it broke down. The damage to the engine of the Insured Vehicle could have been avoided if the Insured Vehicle was laid up immediately instead of being driven. The damage to the engine can thus be considered to be a consequential damage of the Insured Vehicle being driven.

Muhd Nazril
Technical Investigator

Ang Bryan Tani
AMSOE, AMIRTE, AFF SAE, MATAI, AFF.Inst.AEA
Senior Technical Investigator
Technical Investigation & Reconstructionist (SAE-A)