

Your Ref: S0M02VJ5
Our Ref : CI/ASM21005184/D

14 May 2021

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

**TECHNICAL INVESTIGATION REPORT OF INCIDENT INVOLVING THE
INSURED VEHICLE XE 2353H ON 13 OCTOBER 2020**

1. I refer to your request dated 03 February 2021.
2. On 13 October 2020 at about 2110hrs, the insured vehicle XE 2353H (herein referred to as "**Insured Vehicle**") was travelling along Jurong West Avenue 2 when one of its tyres had dislodged, hitting 2 motor cars.
3. My analysis, comments, and opinions with respect to the cause of the Insured Vehicle's tyre dislodging are set out below.

Inspection of the Motor Car

4. The Insured Vehicle was physically inspected by me on 04 February 2021 at the premises of M/s Tong Heng Motor Work, Block 6 Kranji Loop #01-26, Singapore 739542. This was after it was released from Traffic Police pound. The inspection carried out had primarily focused on the tyres of the Insured Vehicle.
5. The Insured Vehicle, under normal circumstance, is fitted with 10 tyres on 3 axles however at the time of my inspection, both the left inner and outer tyres at the 2nd axle were not fitted on the Insured Vehicle. See photo 1 - 4 below.
6. The left inner and outer tyres were retrieved from the container bin of the Insured Vehicle. Overall, I had observed that the 10 tyres of the Insured Vehicle were of serviceable condition and sufficiently inflated for vehicular operation. I did not find any tear, cut or burst mark(s) on the outer and the inner sidewalls as well as across the tread of the 10 tyres. The tyre brand, tyre size and remaining tread depth of the Insured Vehicle's 10 tyres were recorded as follows: -

Allround 295/80 R22.5
(3mm)

Allround 295/80
R22.5 (3mm)

Triangle 295/80 R22.5 (2mm)

REAR	<input type="text"/>	<input type="text"/>	FRONT
	<input type="text"/>	<input type="text"/>	
	<input type="text"/>	<input type="text"/>	
	<input type="text"/>	<input type="text"/>	

Pirelli 295/80 R22.5
(4mm)

Allround 295/80
R22.5 (4mm)

Triangle 295/80 R22.5 (2mm)



Photo 1 shows a general view of the rear left body of the Insured Vehicle. The Insured Vehicle, under normal circumstance, is fitted with 10 tyres on 3 axles however at the time of my inspection, both the left inner and outer tyres at the 2nd axle were not fitted on the Insured Vehicle.



Photo 2 shows a closer view of the 2nd axle and 3rd axle at the left side of the Insured Vehicle. At the time of my inspection, the left inner and outer tyres at the 2nd axle were not fitted on the Insured Vehicle.



Photo 3 shows workers retrieving the left inner and outer tyres from the container bin of the Insured Vehicle.



Photo 4 shows a general view of the left inner and outer tyres at the 2nd axle of the Insured Vehicle that were retrieved from the container bin of the Insured Vehicle.

7. Upon examination of the wheel drum at the left side of the 2nd axle, I had observed that one of the bolts that fits the tyres onto the wheel drum was broken. Rust was also seen on the tread area, and on the broken surface area of the broken bolt. The remaining 9 unbroken bolts had rust on their tread area. Note: Under normal circumstance, 10 bolts and 10 nuts are used to fit and secure the tyres to the wheel drum. All the bolts were not loosely fitted into their respective bolt holes.
8. The Insured Vehicle was impounded at Traffic Police pound for more than 3 months after the incident. The rust that was seen on the 10 wheel bolts could have developed during this period due to the bolts being exposed to natural environmental condition. However, upon review of the incident scene photographs (refer to photograph 11 below), the broken surface area of the broken wheel bolt appears to be already rusted. Hence, it would be reasonable to say that the rust observed, at least on the broken surface area of the broken wheel bolt, had existed before the Insured Vehicle was impounded by Traffic Police. See photo 5 – 10 below.



Photo 5 shows a general view of the wheel drum at the left side of the 2nd axle of the Insured Vehicle at the time of my inspection. 10 bolts are used to fit the tyres to the wheel drum. Out of the 10 bolts, one bolt was broken. All 10 bolts were also observed to be not loosely fitted into their respective bolt holes.



Photo 6 shows a general view of the broken wheel bolt (circled). Rust was seen on the tread area of the broken wheel bolt and similarly seen on the tread area of the remaining 9 unbroken wheel bolts. The broken surface area of the broken wheel bolt was also rusted.



Photo 7 shows a closer view of the broken wheel bolt. Rust was seen on the tread area (arrowed) and broken surface area of the broken wheel bolt.

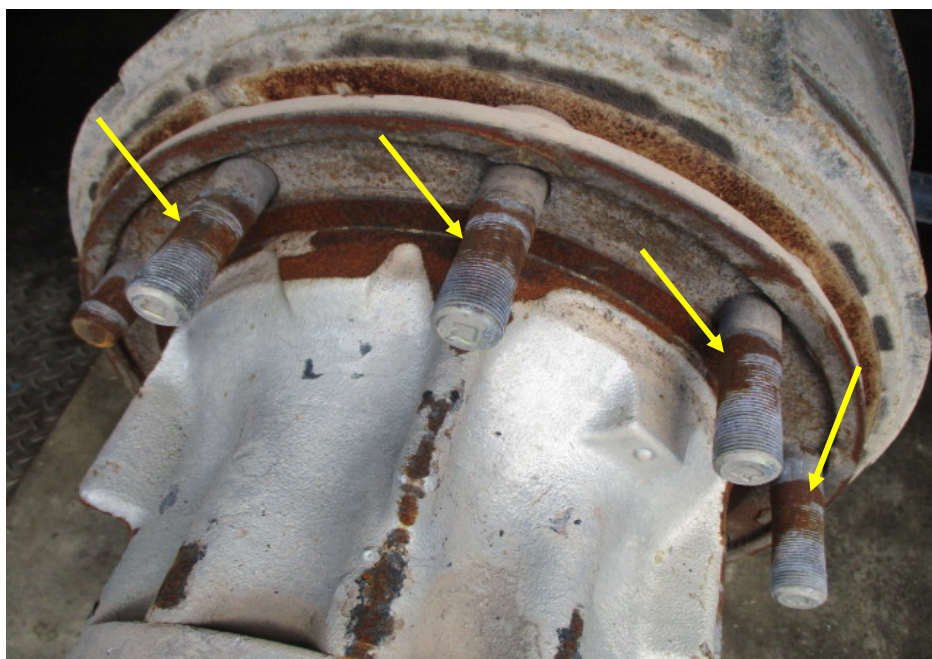


Photo 8 shows a general view of the other remaining unbroken wheel bolts. Similar to the broken wheel bolt, rust (arrowed) was also seen on the tread area of the remaining 9 unbroken wheel bolts. The rust seen on all 10 wheel bolts could have developed due to the bolts being exposed to natural environmental condition during the 3 months plus period when the Insured Vehicle was impounded by Traffic Police. However, upon review of the incident scene photographs, the broken surface area of the broken wheel bolt appears to be already rusted before the Insured Vehicle was impounded (refer to photograph 11 below).

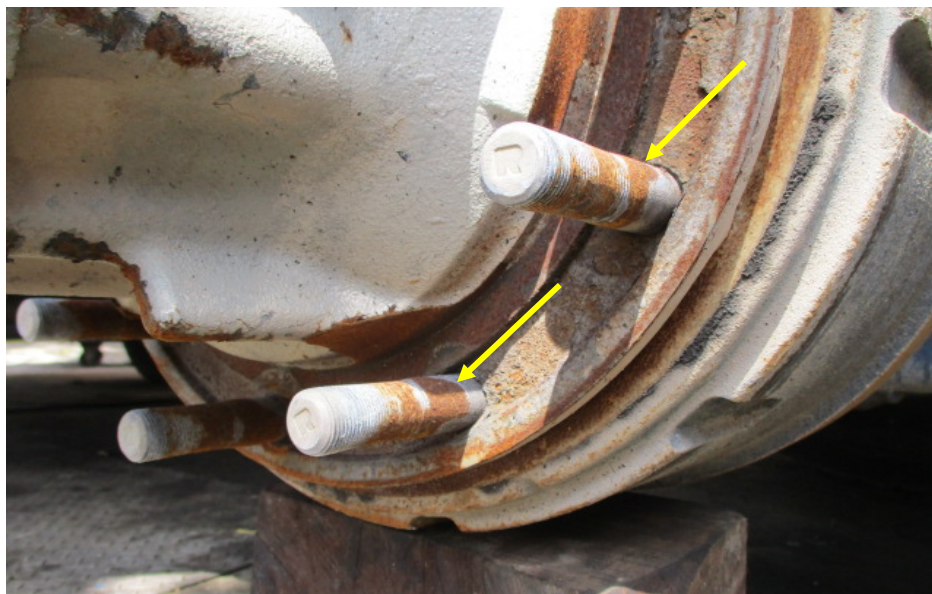


Photo 9 shows a general view of the other remaining unbroken wheel bolts. Similar to the broken wheel bolt, rust (arrowed) was also seen on the tread area of the remaining 9 unbroken wheel bolts. The rust seen on all 10 wheel bolts could have developed due to the bolts being exposed to natural environmental condition during the 3 months plus period when the Insured Vehicle was impounded by Traffic Police. However, upon review of the incident scene photographs, the broken surface area of the broken wheel bolt appears to be already rusted before the Insured Vehicle was impounded (refer to photograph 11 below).



Photo 10 shows a general view of the 3rd axle at the left side of the Insured Vehicle. Under normal circumstance, the tyres of the Insured Vehicle are fitted and secured onto the wheel drum via 10 bolts and 10 nuts as indicated by the yellow arrows.

9. The 10 nuts used to secure the 10 wheel bolts that fit the tyres to the left side of the 2nd axle were missing/not seen at the time of my inspection of the Insured Vehicle.
10. Apart from paragraph 5 to 9 above, no other information, relevant to the purpose of report, could be gathered from my inspection of the Insured Vehicle.

Investigation and Technical Analysis

11. Earlier in paragraph 8, I had commented that the rust that was seen on the broken surface area of the broken wheel bolt had existed before the Insured Vehicle was impounded by Traffic Police. This was determined based on my review of the photographs taken at the incident scene (attached in the investigation report of M/s AJAX Adjustors and Surveyors Pte Ltd, and also attached in the Singapore Accident Statement of the driver of the Insured Vehicle). See photograph 11 below.

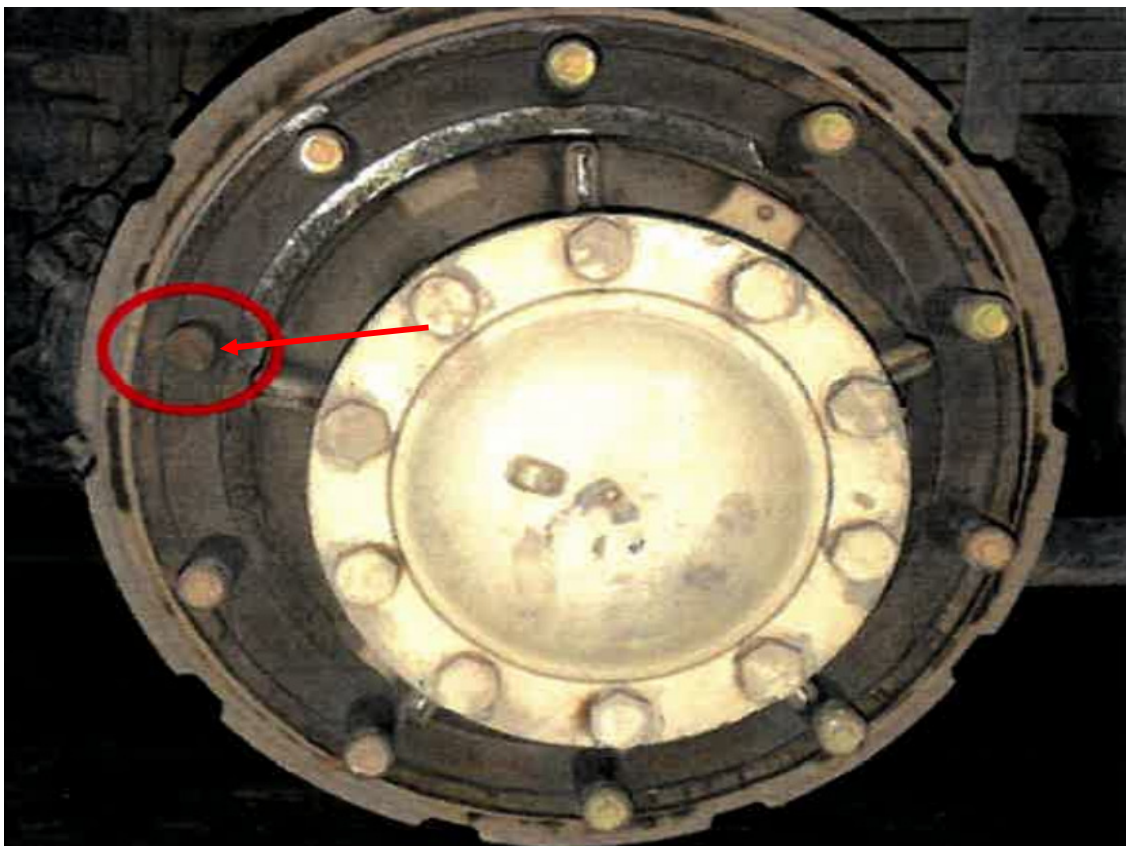


Photo 11 shows the wheel drum at the left side of the 2nd axle (photograph taken at the incident scene) before the Insured Vehicle was impounded by Traffic Police. The broken wheel bolt is highlighted by the red circle. As seen from the photograph, the broken surface area (arrowed) of the broken wheel bolt appears to be covered with dark coloured rusted immediately after the bolt was broken. The condition of all 10 wheel bolts also does not appear to be of new condition.

12. Typical cause(s) of wheel bolt breakage include exposure to impact forces, material stress due to over-stretching, material fatigue due to weakened material strength cause by corrosion.
13. For this case, exposure to impact forces can be ruled out as there was no sign(s) of physical damage to the wheel drum of the Insured Vehicle.
14. Material fatigue because of corrosion weakening the strength of the wheel bolt may be possible, given that rust was seen on the broken surface area of the broken wheel bolt immediately after the bolt was broken. However, it is likely that the rust on the broken wheel bolt had existed for a prolong period of time as the colour of the rust was not of bright orange colour that is normally associated with "fresh" rust.
15. Material stress due to over-stretching is also possible for this case. This can happen when a wheel bolt is over-tightened, resulting in the molecules within the bolt stretching past its maximum tensile strength (tensile strength refers to the resistance of a material to breaking under tension/load). Simply put, when an over-stretched wheel bolt is subjected to tension/load, its ability to withstand the tension/load is affected and may eventually cause the bolt to break.
16. Over-stretching of a wheel bolt can occur when the bolt is tightened without consideration of the torque (turning force). In other words, the force required to turn the bolt to tighten it into the bolt hole. When a wheel bolt is being tightened, the molecules within the bolt stretch and gives rise to tension (tensile strength) within the bolt, clamping objects together. When the torque (turning force) is low, the wheel bolt is not stretched sufficiently to have enough tension and is hence unable to clamp the tyre and wheel hub together effectively. Over time, due to vibrations/rotation/movement, the wheel bolt becomes loosen and may fall off and consequently, the tyre may become dislodged. When the torque (turning force) is too much, the wheel bolt is over-stretched (too much tension) and over time, the wheel bolt may break, and the tyre may become dislodged.
17. When wheel bolts are removed for tyre replacement or work carried out to the undercarriage parts amongst others, the appropriate method is to use a torque wrench to tighten the wheel bolts after the bolts are loosely secured into the bolt holes either by hand or by an airgun. A torque wrench is pre-set to the recommended torque required and thereafter used to tighten the wheel bolts. However, often, the method used to tighten wheels bolts are via an airgun, which simply "fires" and tightened the wheel bolts into the bolt holes. A wheel bolt can easily be over-tightened when an airgun is the only tool used to tighten the wheel bolt.

18. The Insured Vehicle is a tipper truck and is primarily used for heavy industrial purposes like the transportation of sand, soil etc. It would not be uncommon for general servicing work, tyre replacement work, mechanical servicing work etc carried out to such vehicles to be, bare minimum at best. I would not expect a torque wrench to be used to tighten wheel bolts. From my experiences carrying out inspections at heavy vehicle workshops, it is likely that an airgun would be the only tool used to tighten wheel bolts.
19. The documents relating to the servicing and maintenance of the Insured Vehicle are annexed in the investigation report of M/s AJAX Adjustors and Surveyors Pte Ltd. The documents showed that a major servicing/maintenance was carried out to the Insured Vehicle on 30 September 2020 or thereabouts, which is about 13 days before this particular incident. From the description stated in the invoice, several braking components were replaced. This had included the brake drum, lining and inner pump at the left side of the Insured Vehicle 2nd axle. Such nature of work would require the removal and refitting of the tyres at the left side of the 2nd axle. Hence, unless there was removing and refitting of the Insured Vehicle's tyres at the left side of the 2nd axle after 30 September 2020, the last tightening and visual sight of the wheel bolts at the left side of the 2nd axle was about 13 days before the tyre had dislodged from the left side of the 2nd axle. See photo 12 below.

9	Brake, Rear Drum Outer Oil Seal	4	\$	14.00	\$	56.00
10	Tyre, Bolt & Nut	20	\$	26.00	\$	520.00
11	Rear Axle, Driveshaft U-Joint	1	\$	115.00	\$	115.00
12	Brake, Inner Pump	4	\$	250.00	\$	1,000.00
13	Brake, Spring	6	\$	28.00	\$	168.00
14	2nd Hand Rim (REAR L REAR OUTER)	1	\$	80.00	\$	80.00
15	Tyre, 2nd Hand 295/80R22.5 (REAR R REAR)	2	\$	100.00	\$	200.00
16	Skilled labour Fee	1	\$	1,020.00	\$	1,020.00
SGD: Five Thousand Five Hundred Eleven Dollars and Fifty Seven Cents Only						
				Subtotal	\$	5,151.00
				GST (7%)	\$	360.57
				Discount	\$	
				Total Amount Due	\$	5,511.57
Remarks: Replaced REAR R REAR Brake Drum & Lining & Inner Pump						
Replaced REAR L FRONT Brake Drum & Lining & Inner Pump						
Replaced FRONT L&R Lining & Inner Pump & Oil Seal & Bearings						
Replaced ALL 4 Rear Drum Inner and Outer Oil Seal						
Labour fee including repair and diagnosis of uneven braking power on ALL 6 wheels & WORN U-joint						
Replaced ALL 6 Brake Shoe Springs						
Installed NEW tyre bolt & nut on NEW brake drum						
Replaced FRONT L Brake Shoe						
Terms & Conditions:						
1) Goods sold are not refundable						
2) Cheques should be crossed and made payable to TIONG HENG TRANSPORT.						
Authorised Signature & Company Stamp						

Photo 12 shows the work carried out to the left side of the Insured Vehicle's 2nd axle (arrowed). This was extracted from the invoice dated 30 September 2020. Such work would require the removal and refitting of the tyres at the left side of the 2nd axle.

20. On the same invoice dated 30 September 2020, I also note that there was 20 pieces of tyre bolts and nuts replaced. There was however no mention of which tyres the new bolts and nuts were for. Notwithstanding this, it is likely that the new 20 pieces of tyre bolts and nuts were not for the tyres at the left side of the Insured Vehicle's 2nd axle given that rust was seen on the broken surface area of the broken wheel bolt. Furthermore, the condition of all 10 wheel bolts at the left side of the 2nd axle, as seen from the incident scene photographs, do not look like new wheel bolts.
21. Human eye will not be able to determine whether a wheel bolt is in an over-stretched condition however if any of a wheel bolt has rust developing on its exterior surface area, it will be visible. Re-using a wheel bolt that is over-stretched and/or rusted poses a risk of the bolt breaking. Ideally, a wheel bolt that is tightened purely by an airgun without the use of a torque wrench should not be re-used. Similar for a wheel bolt that has rust on its exterior surfaces should also not be re-used. However, it is not a common practise in the industry to replace wheel bolt(s) after a single use. In this aspect, it would not be unusual that the 10 wheel bolts at the left side of the Insured Vehicle's 2nd axle were not replaced when it was last removed on 30 September 2020 or thereabouts.

Conclusion

22. Having inspected the Insured Vehicle and reviewed the documents provided to me, in particular the investigation report of M/s AJAX Adjustors and Surveyors Pte Ltd, and the Singapore Accident Statement of the driver of the Insured Vehicle, I am of the view that the cause of the Insured Vehicle's tyre dislodging was due to a broken wheel bolt arising from either material stress due to over-stretching of the wheel bolt or material fatigue due to corrosion of the wheel bolt, or a combination of both conditions.



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