



Office of Transport Safety Investigations

TECHNICAL INSPECTION FINDINGS

STATE TRANSIT AUTHORITY BUS MO 3881 FIRE

FRENCHS FOREST

1 OCTOBER 2013



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THE OFFICE OF TRANSPORT SAFETY INVESTIGATIONS

The Office of Transport Safety Investigations (OTSI) is an independent NSW agency whose purpose is to improve transport safety through the investigation of accidents and incidents in the rail, bus and ferry industries. OTSI investigations are independent of regulatory, operator or other external entities.

Established on 1 January 2004 by the Transport Administration Act 1988, and confirmed by amending legislation as an independent statutory office on 1 July 2005, OTSI is responsible for determining the causes and contributing factors of accidents and to make recommendations for the implementation of remedial safety action to prevent recurrence. Importantly, however, OTSI does not confine itself to the consideration of just those matters that caused or contributed to a particular accident; it also seeks to identify any transport safety matters which, if left unaddressed, might contribute to other accidents.

This OTS investigation was conducted under powers conferred by the Passenger Transport Act 1990. OTSI investigators normally seek to obtain information cooperatively when conducting an accident investigation. However, where it is necessary to do so, OTSI investigators may exercise statutory powers to interview persons, enter premises and examine and retain physical and documentary evidence.

It is not within OTSI's jurisdiction, nor an object of its investigations, to apportion blame or determine liability. At all times, OTSI's investigation reports strive to reflect a "Just Culture" approach to the investigative process by balancing the presentation of potentially judgemental material in a manner that properly explains what happened, and why, in a fair and unbiased manner.

The Incident

At 18:12 on 1 October 2013 State Transit Authority (STA) bus MO 3881 experienced a fire in the rear engine bay while operating on passenger Route L60. The bus was travelling on Warringah Road and turned into Wakehurst Parkway when it misfired. At about the same time, the driver observed black smoke emanating from the rear of the nearside of the bus in his rear vision mirror. He turned into Frenchs Forest Road at Frenchs Forest and stopped.

After evacuating his passengers, the driver took his portable fire extinguisher and went to the rear of the bus. He opened the nearside engine bay hatch and observed flames from a small fire on the nearside of the engine near the turbocharger. He was able to successfully extinguish the fire by discharging the portable dry chemical (powder) extinguisher at the seat of the fire.

The driver alerted the STA Radio Room to the incident. The Radio Room called Fire and Rescue NSW who attended and confirmed the fire was fully extinguished. The bus was then towed to the STA's Leichhardt Depot and quarantined pending examination by STA and OTSI investigators.

The prompt action by the bus driver in switching off the engine and discharging the portable fire extinguisher prevented further damage within the engine bay and prevented the fire escalating and possibly spreading into the interior of the bus.

The Bus

The bus was a 6 cylinder diesel-powered Volvo Model B10BLE bus with an Orana body. It was introduced into service in 1998, one of 124 of this model purchased to operate STA metropolitan passenger services. At the time of the fire it was attached to the Brookvale Depot and its odometer was reading 811,545 km.

The bus was licensed to carry 62 passengers, 43 seated and 19 standing. At the time of the fire there were 24 passengers onboard with 10 seated in the lower front section and 14 in the rear raised section of the bus. It was fitted with two bifold opening exit/entry doors, one at the front and the other halfway along the bus. It also had two window emergency exits.

The bus was equipped with a 2.5kg portable dry chemical extinguisher located in the front of the bus near the driver's console. It did not have a fire suppression system or fire detection sensors or alarms fitted.

The Driver

The driver obtained his heavy vehicle license in 1983 and had 12 years experience driving buses with the STA. He was holding a current public passenger bus driver authority issued by Roads and Maritime Services (RMS). He had received training in emergency procedures but had not received any fire fighting training with the STA.

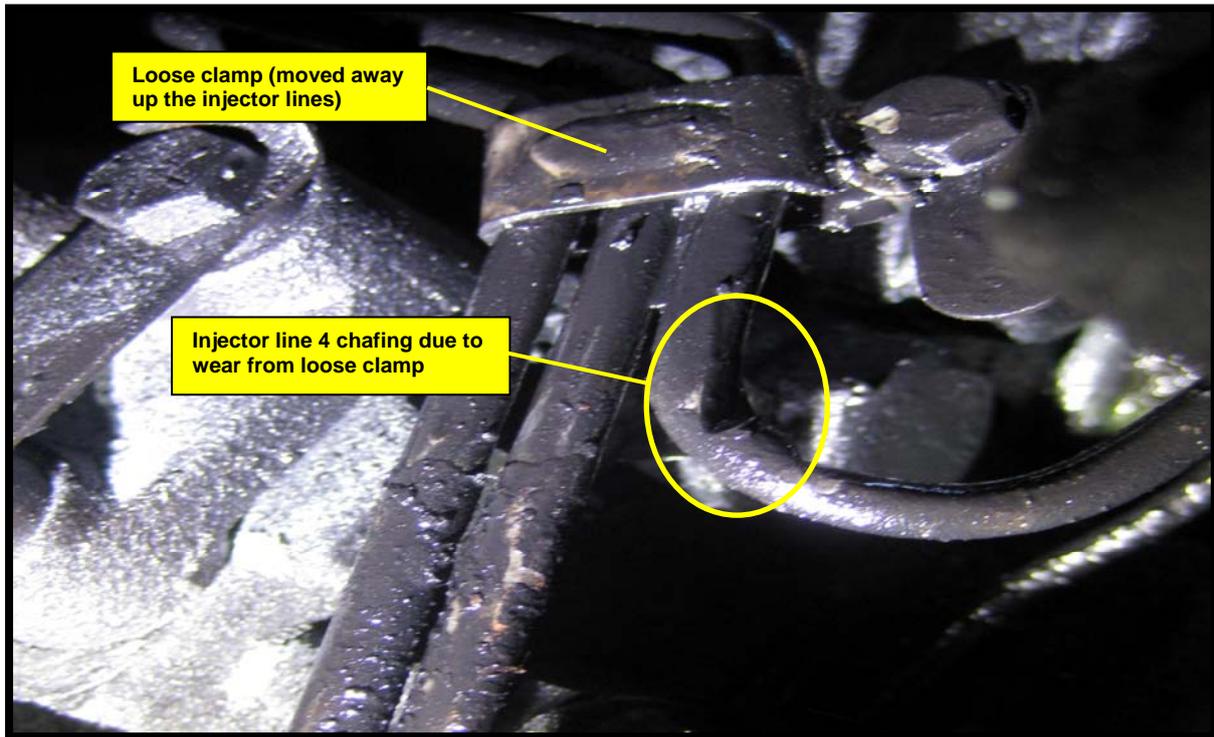
Examination

STA and OTSI investigators attended Leichhardt Depot on 2 October 2013 to examine the bus.

The examination revealed that the fire had started on the nearside of the rear mounted engine resulting in only comparatively minor damage to the engine and associated wiring and hoses. That the damage was minimal may be attributed to the prompt action by the driver in detecting the fire, shutting off the engine and utilising the portable fire extinguisher.

There were heat patterns on the manifold and the turbocharger housing indicating diesel fuel had sprayed on to the hot surfaces and ignited. However, the turbocharger was not damaged nor was there any damage to other components of the engine.

Examination of the high pressure fuel lines identified a retaining clamp on the Nos. 4, 5 and 6 injector lines near the injector end that had slipped downwards along the lines. It had come to rest at a bend in the No. 4 injector line and, over a period of time, had worn through the line until a hole had been created (see *Photograph 1*). This hole would allow diesel fuel under pressure of approximately 210 bar (3050 psi) to spray from the fractured line on to the hot turbocharger housing and exhaust manifold surfaces. As it burnt off on contact with the hot surfaces, the diesel fuel would have produced a significant volume of black smoke. It was this smoke that alerted the driver to a problem, in conjunction with the backfiring of the engine.



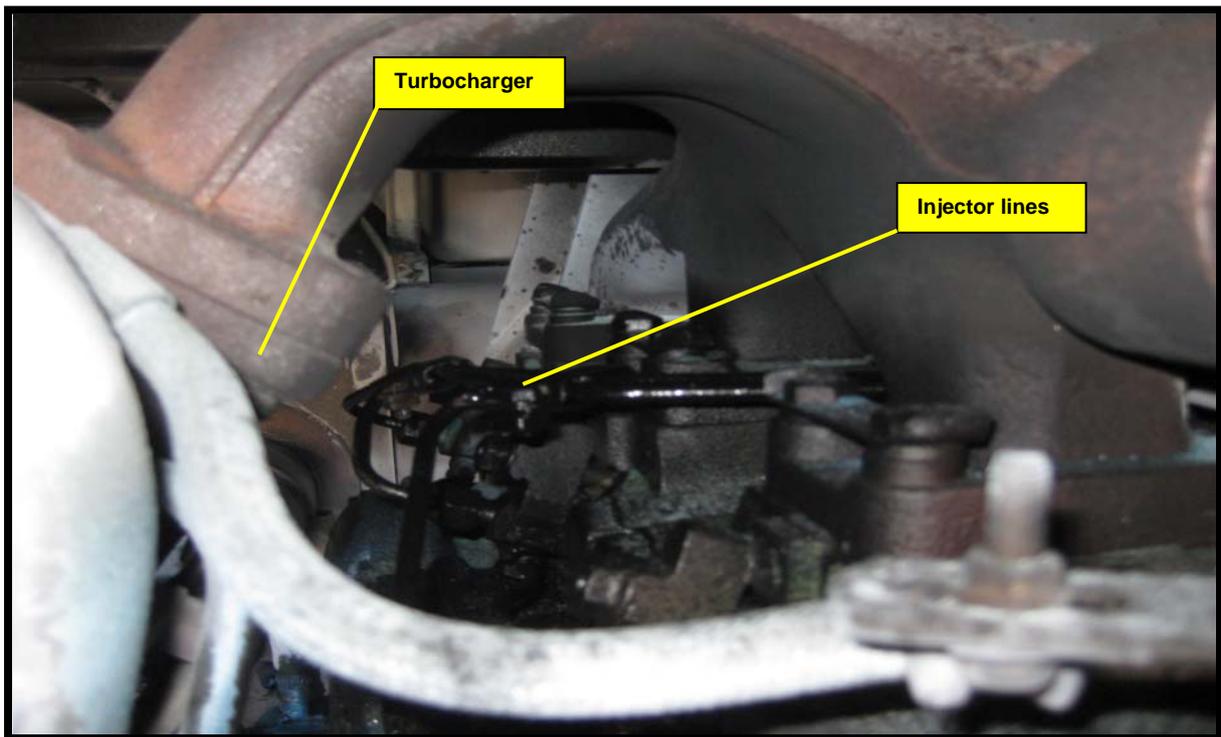
Photograph 1: No. 4 injector line chafing

The 1-2-3 injector lines were accessible for both visual and manual inspection. However, the 4-5-6 injector lines were located in a position inaccessible for manual and visual inspection due to their close proximity to the turbocharger (see *Photograph 2*). The clamp on the 4-5-6 lines should have a flexible rubber insert separating the line from the metal clamp to prevent friction and wear. This rubber insert also acts to absorb some of the vibration of components.

The rubber insert was found to be missing between the clamp and the injector. This allowed the clamp to move from its installed position down to the bend in the line which prevented it from moving further. The resulting metal to metal contact had worn through the wall of the injector line under the effect of the vibration of the engine under normal operating conditions (see *Photograph 3*).

Servicing and maintenance

Examination of the service records and work orders for MO 3881 did not reveal any record of work having been undertaken on the injector lines since the bus came into operation in 1998. In the absence of any evidence to the contrary, it is probable that the injector lines and clamps in place were original components.



Photograph 2: Injector lines in close proximity to the turbocharger



Photograph 3: Clamp and injector and resultant wear

The last biannual service of MO 3881 was carried out on 12 May 2013 (Work Order 002026830). It was noted that under section “Engine Bay” of the work order that the security and condition of the fuel lines and clamps are required to be inspected. The work order records that the clamps and fuel lines were in a serviceable condition.

The bus had last undergone a mandatory biannual inspection which was carried out by Roads and Maritime Services (RMS) under the Heavy Vehicle Inspection Scheme on 9 May 2013. Inspection Report AY 0184290 indicates no defects were detected.

Conclusion

The fire in the engine bay of the STA bus MO 3881 was caused by fuel spraying under high pressure from a hole in the No.4 injector line on to the hot exhaust manifold and turbocharger causing the fuel to ignite. The breach in the injector line was the result of friction between the line and a loose retaining metal clamp which had become loose and moved from its installed position after its flexible rubber insert went missing.

STA Remedial Action

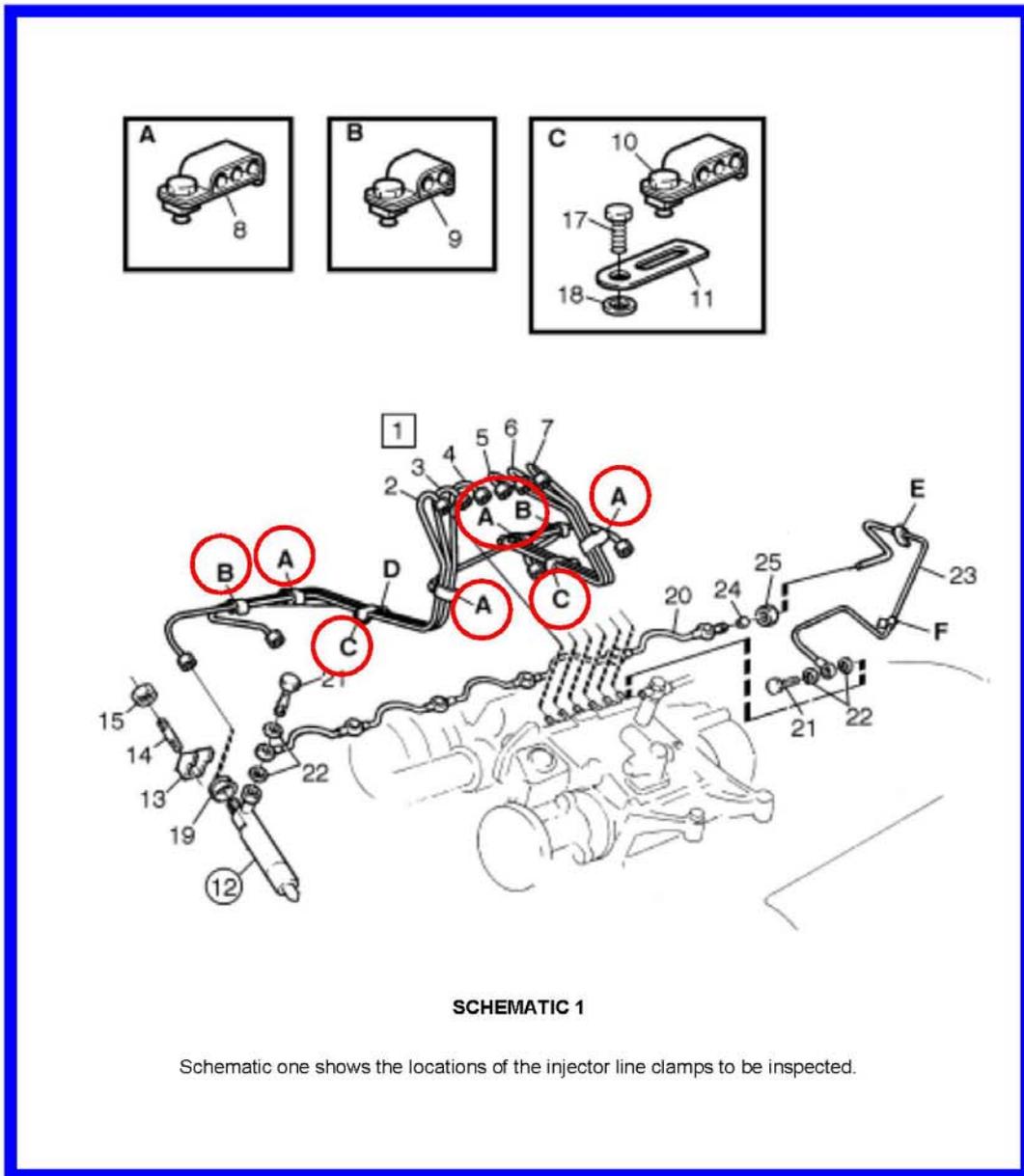
After determining the cause of the fire the STA immediately issued Maintenance Alert No. WI 26.01.33 to all depot service managers requiring all the 124 Volvo model B10BLE and B10B buses in the fleet to be inspected without delay (see *Annexure A*). The inspection required high pressure injector lines to be examined for signs of leakage or insecurity with particular attention for signs of injector line wear or missing clamp rubber insert gaskets.

OTSI has concluded its examination of the circumstances of this incident and has determined that, in view of the remedial action taken by STA, it does not require further investigation under the provisions of Section 46BA (1) of the *Passenger Transport Act 1990*.

A copy of these Findings has been provided to the State Transit Authority and the Roads and Maritime Services (as the NSW Bus Regulator).

Annexure A: STA Maintenance Alert

MAINTENANCE ALERT	
Title: VOLVO B10BLE & B10B – SECURITY OF INJECTOR LINES	
Attention of: Regional Fleet Managers, Regional Service & Compliance Manager, Service Managers, Service Coordinator (Burwood & Mona Vale)	
Date Issued: 2nd October 2013	Maintenance Alert No: WI 26.01.33
ISSUE	
Following a thermal incident with a Volvo B10BLE on 1 October 2013, and an earlier incident of similar nature on a Volvo B10BLE on 13 May 2012 there is a need to ensure high pressure injector lines are examined for signs of leakage, damage or insecurity.	
INSTRUCTION	
Particular attention is to be paid to the high pressure injector line clamping for security, signs of injector line wear or missing clamp rubbers.	
Inspection and checking of the following must be undertaken:	
<ol style="list-style-type: none"> 1. All clamps are correctly fitted, positioned and secured (see Schematic 1), 2. Particular attention must be given to clamping on injector lines 4, 5 and 6 in the area behind the Turbocharger (Caution – beware of possible hot turbo and exhaust components), 3. Remaining injector lines and clamps are to be checked. 4. Return lines should also be checked for obvious signs of deterioration. 5. Where injector clamps are insecure, or signs of clamp movement are evident, the injector line must be examined for signs of wear. 6. If there are signs of wear on high pressure injector lines prompting replacement of the component, vehicles are to be stopped and referred for a further assessment by management. 7. If any injector line has wear that requires replacement, the lines are to be replaced as a complete set and in conjunction with Maintenance Instruction MI 07.06.01. 8. Work orders are to be created in Ellipse for any additional work as a result of this inspection. 9. Where management decide it is safe to reschedule injector line replacement, the Ellipse work order must be updated to keep an appropriate record of that decision. Works orders must be raised and correctly prioritised. 	
To facilitate accurate monitoring of these inspections, work orders will be created in Ellipse with all inspections completed by 8.00am, Tuesday the 8 th of October 2013 inclusive of a summary of inspection results to be emailed to the Manager, Fleet Policy and Standards.	



SCHEMATIC 1

Schematic one shows the locations of the injector line clamps to be inspected.