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Report Ref: 10010581

Test Facility: T2857
Test Vehicle: 12/04 Toyota Landcruiser Tray
VIN: JT731PJ7508534938
Engine No: 1HZ0176178
Reg No: WILLLS (Vic)

Design Check to ADR35/01 Commercial Vehicle Braking Systems

Preamble

The purpose of this section of this report is to provide sufficient evidence to confirm compliance with the design requirements of ADR 35/01

Results of Inspection and Test

5.1 General

ADR 35/01 Clause	Assessment	Complies Y/N
5.1.1	Split vacuum power assisted hydraulic system present – service brake system is operable on all four wheels through a single foot operated control.	Y
5.1.2	One service brake failure waring lamp is fitted from original manufacture and operation is unaffected by modifications to vehicle	Y
5.1.3	Single method of service brake application is provided in the form of a foot pedal which is operated by the driver's right foot.	Y
5.1.4	As each service brake on each wheel is of the disc type, these automatically compensate for pad wear and vehicle therefore satisfies this clause.	Y
5.1.5	N/A – ABS not fitted	-
5.1.6	All components using in braking system meet at least one recognised international or national standard where such standards exist for the component in question. Specifically, all components used on service brake system are either present from original manufacture or are sourced from recognised production vehicles.	Y
5.1.7	N/A – no traction control present	-
5.1.8	N/A – no couplings present	-
5.1.9	N/A – vehicle not equipped to tow a trailer using are at positive pressure.	-
5.1.10	N/A –Rated towing capacity for braked trailer is 3500 kg.	-
5.1.11	N/A - service brake system does not incorporate a brake power unit.	-
5.1.12	N/A – compressed air braking system not fitted.	-

5.2 Visible Indicators

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ADR 35/01 Clause	Assessment	Complies Y/N
5.2.1	Two visible indicators are present. These have ISO labelling and indicate low service brake fluid level and parking brake applied.	Y
5.2.2	Service brake failure warning lamp operates under condition B. This original system is unaffected by modifications to vehicle.	-
5.2.3	N/A – brake power unit not fitted.	-
5.2.4	N/A – vehicle not equipped to tow a trailer using air at positive pressure.	-
5.2.5	Separate visual indicators provided.	Y
5.2.6	Low fluid warning illuminates when ignition is turned to the ON position and extinguish when engine starts. Lamp also remains lit if any uncorrected fault exists in the system and the engine is running.	Y
5.2.7	N/A – automatic transmission not fitted.	-
5.2.8	Once activated to signal a failure, lamp(s) remain lit whenever ignition is switched ON and fault(s) remain uncorrected.	Y
5.2.9	Visual indicators are lamps – ie not mechanically operated.	Y
5.2.10	ISO symbol present on all visual indicator lenses.	Y
5.2.11	N/A – service brake failure warning lamp is not mechanical	-
5.2.12	Location of visible indicators is such that they may be easily read by the driver whilst seated in the normal driving position. Location is unaffected by modifications to braking system.	Y

5.3 Parking Brake

ADR 35/01 Clause	Assessment	Complies Y/N
5.3.1	Parking brake retention is by mechanical means only and braking effect is by friction forces between tailshaft mounted disc and brake pad assembly.	Y
5.3.2	Separate control for parking brake activation is provided. This is operated by the driver's left hand and is as originally fitted by the vehicle manufacturer to the requirements of this ADR. Release requires pull up, then press button.	Y
5.3.3	Means of adjustment is provided at parking brake disc.	Y
5.3.4	Operation of brake is by driver's hand left and is within easy reach when driver is seated in the normal driving position.	Y
5.3.5	N/A – vehicle not equipped to tow trailer fitted with compressed air braking system.	-
5.3.6	N/A	-
5.3.7	N/A	-

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5.4 Parking Brake Indicator Lamp

ADR 35/01 Clause	Assessment	Complies Y/N
5.4.1	One red lamp with ISO symbol is provided which illuminates whenever the parking brake is applied.	Y
5.4.2	Separate lamps are provided for parking brake and service brake failure.	Y
5.4.3	ISO symbol present	Y
5.4.4	Symbol illuminates with lamp as it forms part of the illuminating surface of the lamp.	Y
5.4.5	Letter "P" on lamp lens is more than 3 mm high. Colour of lens = red.	Y
5.4.6	Located as per 5.2.12 above.	Y

5.5 Secondary Brake System

ADR 35/01 Clause	Assessment	Complies Y/N
5.5.1	Secondary brake system is present by virtue of split vacuum/ hydraulic system with two independent systems such that failure in one subsystem does not result in failure of the other.	Y
5.5.2	Split system present	Y
5.5.3	Secondary brake system consisting of elements of the service brake system is activated by the driver's right foot using the service brake control.	Y
5.5.4	The control for the secondary braking system is capable of releasing and applying the secondary brake after its first application with the control being operated by the driver whilst seated in the normal driving position.	Y
5.5.5	Secondary brake system consists of elements of the service brake system.	Y
5.5.6	N/A – spring brakes not present.	-
5.5.7	N/A –brake power assist unit not fitted.	-
5.5.8	N/A – vehicle not equipped for towing a trailer, the braking system of which uses air at positive pressure.	-
5.5.9	N/A	
5.5.10	N/A	

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5.6 Special Provisions for all Vehicles with Hydraulic Brakes

ADR 35/01 Clause	Assessment	Complies Y/N
5.6.1	Master cylinder reservoir is divided into two compartments, one of which services the front brake circuit and the other serving the rear. Master cylinder reservoir volume and relationship between this and fluid displaced by a full stroke of the master cylinder is unaffected by the modification as the original equipment master cylinder and reservoir assembly is retained.	Y
5.6.2	Master cylinder reservoir volume = >300 ml For front brakes, 138 ml of fluid is required for full travel from the new lining, fully retracted position to the worn lining, fully engaged position. Similarly, 76 ml is required for the rear brake circuit. Total volume of fluid required = 214 ml. This exceeds the master cylinder reservoir volume of >300 ml.	Y
5.6.3	N/A - no pistons or accumulators are present and therefore do not have to be charged for the purpose of storage of energy	-
5.6.4	Master cylinder label is fitted to master cylinder reservoir from original manufacture. As this is retained, vehicle continues to comply with the requirements of this ADR.	

5.7 Special Provisions for Vehicles Using Stored Energy

ADR 35/01 Clause	Assessment	Complies Y/N
5.7.6	Vehicle continues to comply with this clause on the basis that the power assist unit is as originally fitted and is unaffected by the replacement of the rear service brakes.	Y
5.7.7	Vehicle continues to comply with this clause on the basis that the power assist unit and the vacuum pump and reservoir servicing it are as originally fitted and is unaffected by the replacement of the rear service brakes.	Y
5.7.8	N/A – no energy is supplied to any device or system other than to the service brakes.	-
5.7.9	N/A – braking system does not incorporate a brake power unit operating at positive pressure.	-

Conclusion

The subject vehicle was found to meet the requirements of section 5 of ADR 35/01.

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Performance test to VSB6 – ADR 35/091 Commercial Vehicle Braking Systems

Test Facility: T2857
Test Vehicle: 12/04 Toyota Landcruiser Tray
VIN: JT731PJ7508534938
Engine No: 1HZ0176178
Reg No: WILLLS (Vic)

Preamble

The purpose of this section of this report is to provide sufficient evidence to confirm compliance with the performance requirements of VSB6 and therefore to ADR 35/01. A laden and unladen test to the requirements of clause 19.5 of VSB 6 was carried out. In addition, a laden parking brake test to the requirements of clause 8.16 of ADR 35/01 was carried out.

Test Equipment

A calibrated "Autostop Maxi" combined pedal pressure and acceleration data logging device was used to generate the accompanying performance graphs and summary of results for both laden and unladen tests. A calibrated load cell as fitted to the above meter was used as an indicator of control pressure for the parking brake test.

A calibrated digital protractor was used to confirm that slope on which parking brake test was performed meets the particular test conditions of ADR 35/01, while a wristwatch was used to confirm t hat vehicle remained stationary for a period exceeding 5 minutes in both directions.

Test Program

Vehicle was loaded to 3380 kg, thereby exceeding the manufacturers original GVM of 3200 kg. Refer accompanying weigh ticket 33019.

The following test modes were considered:

- Service brake laden – low speed
- Service brake laden – medium speed
- Service brake laden – high speed
- Laden partial failure – failed front brake circuit
- Laden partial failure – failed rear brake circuit
- Laden partial failure – failed power assist unit (vacuum exhausted from system prior to test)
- Laden partial failure – load sensing proportioning valve disconnected
- Service brake unladen – low speed
- Service brake unladen – medium speed
- Service brake unladen – high speed

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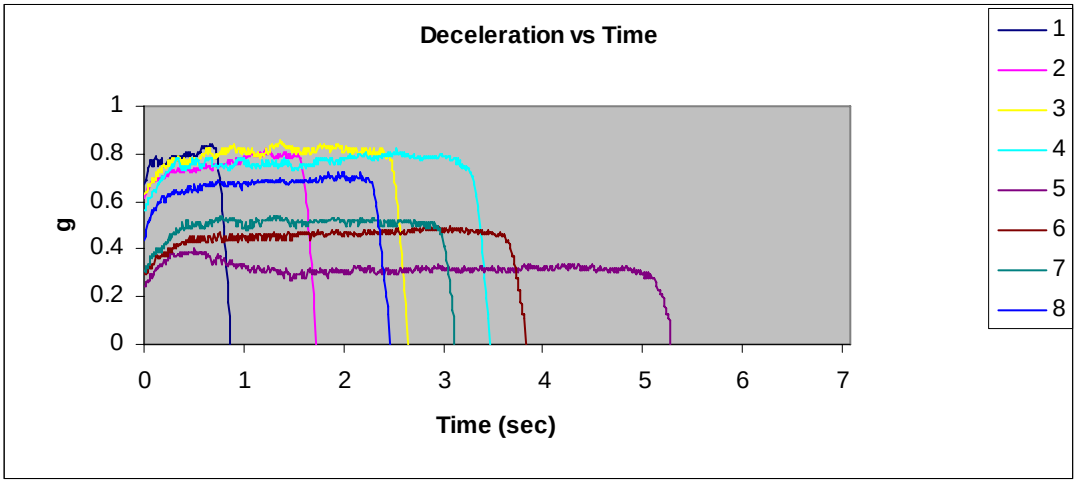
Summary of Results – Laden Test

Test No	1	2	3	4	5	6	7	8
						Laden partial failure		
Mode	Service brake laden	Service brake laden	Service brake laden	Service brake laden	Front	Rear	Power assist	Load sensing proportioning valve
Aveg:	0.74 g	0.73 g	0.78 g	0.74 g	0.32 g	0.44 g	0.49 g	0.65 g
Maxg:	0.84 g	0.82 g	0.86 g	0.82 g	0.40 g	0.50 g	0.54 g	0.72 g
Max Pedal Effort: N	251.0	265.1	305.2	283.1	501.0	376.5	657.7	431.7
dT: sec	0.85	1.70	2.61	3.43	5.22	3.78	3.08	2.43
dV: kph	22.2	44.0	71.6	90.1	58.1	59.2	53.3	55.6
dS: m	2.6	10.4	25.9	42.9	42.1	31.1	22.8	18.8
Brake Delay: sec	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08
MFDD: m/s^2	7.56	7.37	7.91	7.47	3.04	4.51	5.05	6.65

Performance Graphs – Laden Test



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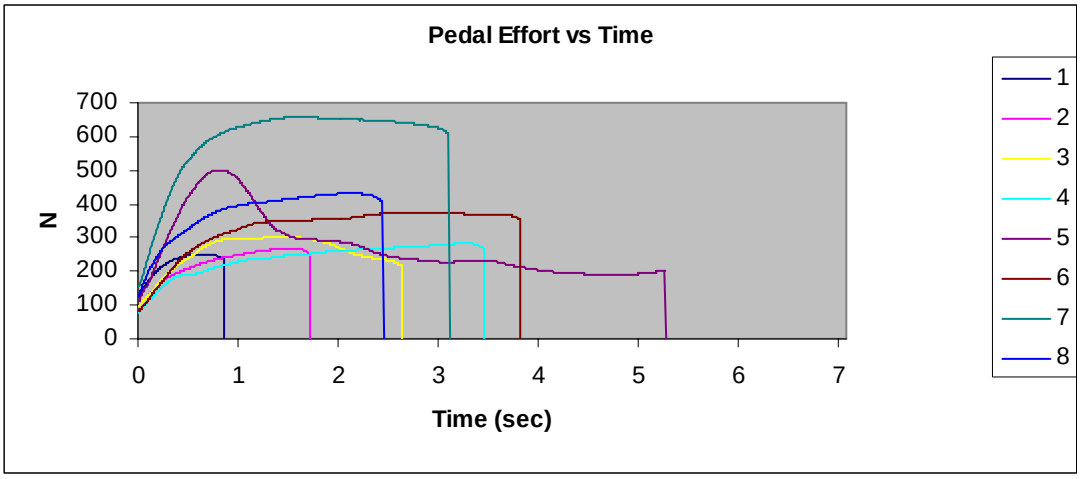
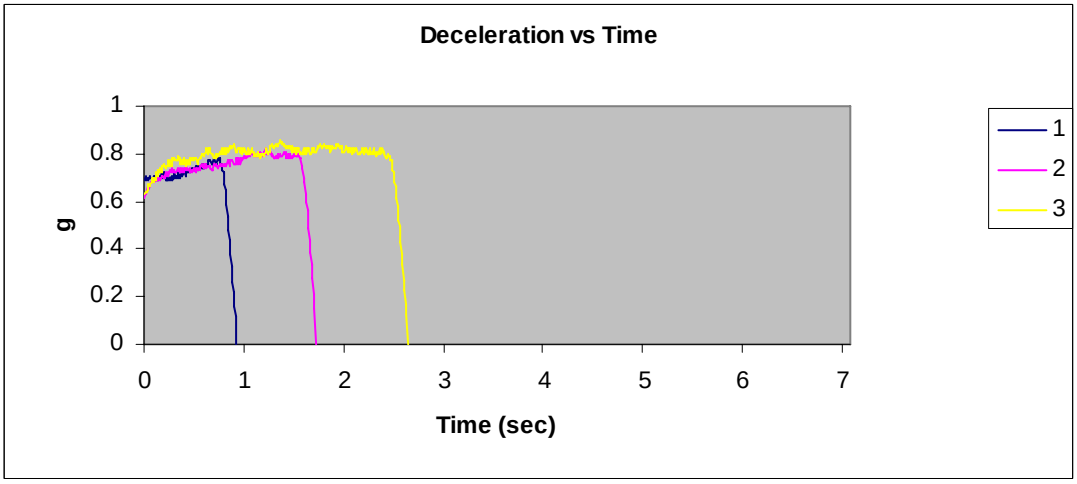


Summary of Results – Unladen Test

Test No	1	2	3
Aveg:	0.68	0.77	0.80
Maxg:	0.78	0.90	0.92
Max Pedal Effort: N	251.0	149.6	190.8
dT: sec	0.91	1.63	3.40
dV: kph	21.9	44.4	96.5
dS: m	2.8	10.1	45.5
Brake Delay: sec	0.07	0.08	0.07
MFDD: m/s^2	6.92	7.84	8.13

Performance Graphs – Unladen Test



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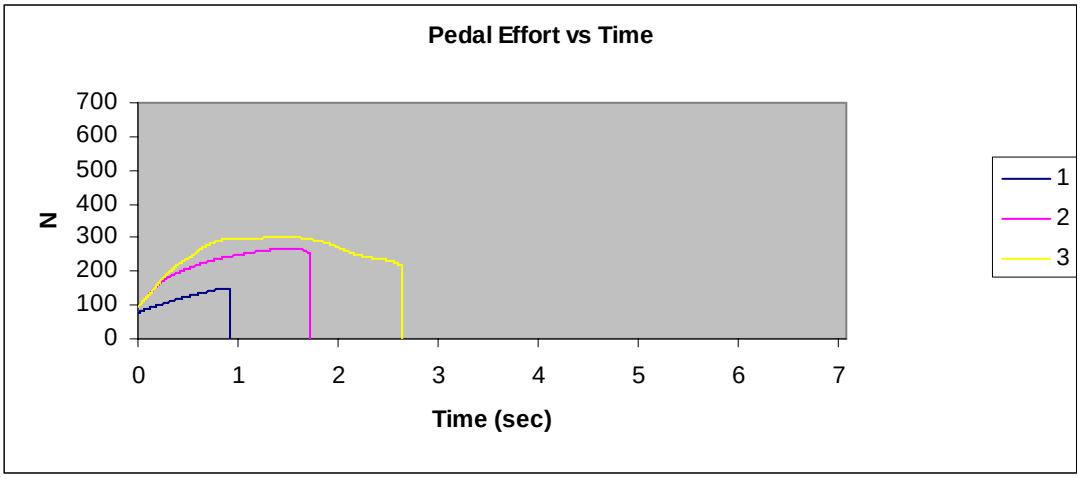

Parking Brake Test

Slope was found to equal 11.2 degrees which exceeds the required gradient of 18%.

The following results were achieved:

Mode	Control Force	Observation
Facing down slope	568N	Vehicle remained stationary for more than 5 minutes
Facing up slope	551N	Vehicle remained stationary for more than 5 minutes

Load was applied at the centre of the hand grip of the parking brake lever, 50 mm from its free end.

Parking brake system was not burnished prior to the test.

Post-test Inspection

No cracking, separation, distortion or other failure of any component was observed. All elements of the service brakes and parking brake were found to be mounted in their same relative positions, performed their same functions and retained their original effectiveness following the tests referred to above.

Conclusion

Subject vehicle meets the performance requirements outlined in VSB6 and is therefore assessed as continuing to meet the performance requirements of ADR 35/01.

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Strength Test – Modified Toyota Landcruiser rear hubs and brake caliper mounting brackets

Test date: 9th April 2003

Preamble

The client requested the development of a test program to validate the strength of a kit designed to replace the rear service brakes on Toyota Series 78/79 Landcruisers

Parts list – rear service brake assembly

Ref	Qty	Part No	Description
1	2	DRG26438	Caliper mount plate
2	8	M1212542	Stud M12 x 1.25 x 42 long (S457)
3	8	NUTM12125	Nyloc nut M12 x 1.25
4	2	DBA2749	Disc rotor
5L	1	B851/193	Caliper full assembly LH sleeved to 48mm with pads
5R	1	B851/194	Caliper full assembly LH sleeved to 48mm with pads
			Each caliper assembly comprising
5A	2	B171-012	Slide Pin Bolt
5B	2	K823-023S	Slide Pin
5C	1	K846-012	Bleeder Screw
5D	1		Caliper Body
5E,G,K	1	COHKIT	Caliper Seal Rubber Parts Kit
5F	1	PISTON	Caliper Piston 48mm s/s
5H	2		End Shim
5I	1pr	RPAD	Brake Pads inner and outer (spares for 2 calipers)
5J	1	CRADLE	Caliper Cradle
6	4	M1212535	Bolts hex head M12 x 1.25 x 35 long zinc plated
7	4	25137	Spacer washer 25o/d 13i/d 7mm thick
8	4	M12WASHER	Spring washer M12
9	10	CS0515	C/sunk socket set screw ½" unf by 1½ long
10	10	NUT05	Metalock nut ½" unf
11	2	HOSE	Brake hose 10mm banjo and 10mm female fittings. 345 long
12	2	DRG27310	Bracket for hose to mount plate.
13	2	M10BANJO	Banjo bolt M10
14	4	10CW	10mm copper washer.
15	2	CLIP	Hose clip.

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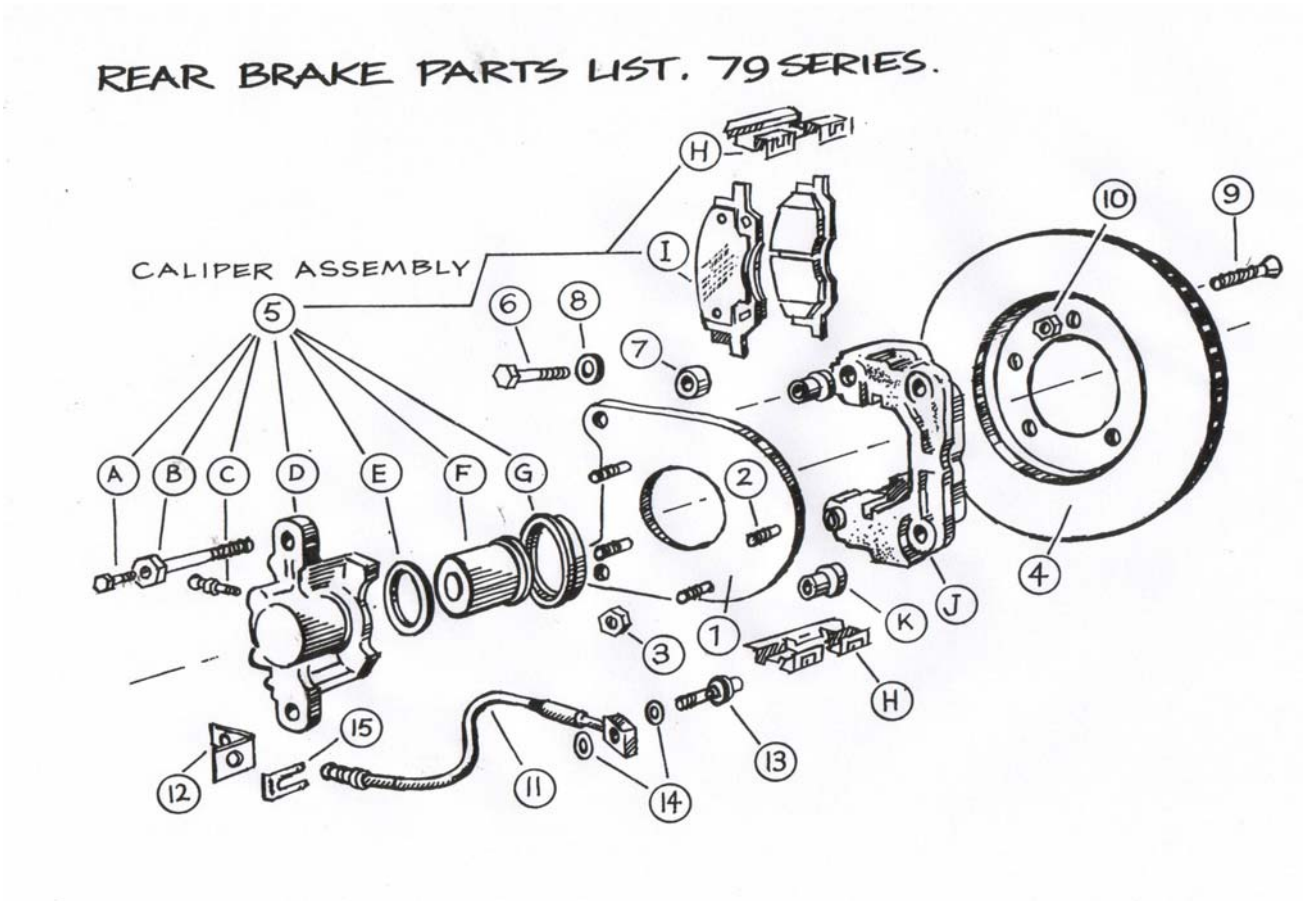

Parts List – Parking Brake assembly

Ref	Qty	Part No	Description
1	1	323100	1 off forward pull handbrake assy 323100
			Each parking brake caliper comprising
1A	1	323100B	Caliper Body
1B	1pr	HPAD	Brake Pads
1C	1	323114	Thrust Block
1D	1	323123	Bolt M10 X60 s/s
1E	1	M10WASHER	Washer M10 s/s
1F	1	323120	Nylock nut M10 s/s
1G	1	323122	Locknut M10 s/s
1H	1	323124	Bolt M10 x 50 s/s
1J	1	SPLPIN	Split pin 5mm by 120mm
2	1	DRG24297	Adapter plate
3	1	HANDLE	Steel square section handle 20 x 20 x 200 long.
4	2	1352513	Spacer Sleeve 13.5 thick, 25 o/d 13 i/d

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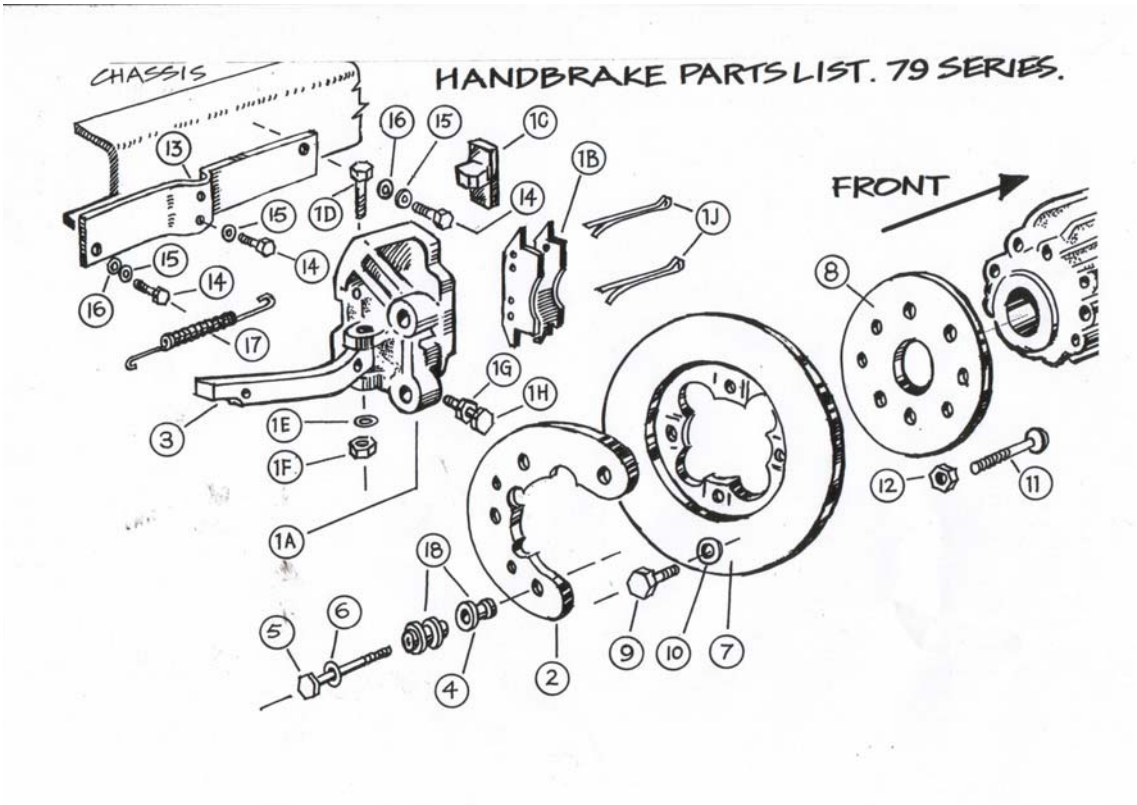
5	4	UNC275	Cap screw 7/16 UNF by 2.75 grooved head
6	4	S/WASHER	Shakeproof washer 7/16.
7	1	DR363	Disc Rotor Mild Steel Plate
8	1	DR24298	Disc Rotor Carrier Plate
9	4	M101525	Hex bolt M10 x 1.5 x 25 long zinc plated
10	4	M10WASHER	Spring washer M10
11	4	7162	Stud 7/16 UNFx 2 inch long S141
12	4	NUT716	Nyloc nut 7/16 unf
13	1	505300	Cable end mounting plate 50 x 5 x 300 long
14	3	M812520	Hex Bolt M8 by 1.25 x 20 long
15	2	M8WASHER	Flat washer M8 x1 mm thick.
16	3	M8SWASHER	Spring washers. M8
17	1	SPRING	Spring 150 mm long C-231
18	4	P9303	Slide Seal



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Test Method

It was agreed with the client that a static test procedure be used to confirm the strength of the modified rear hub, caliper mounting brackets and associated components. A rear axle and differential housing sourced from a Toyota Landcruiser was fitted with a complete modified rear hub and replacement service brake assembly as shown:

Loading was applied using a 3 tonne capacity hand puller and 7 tonne capacity hydraulic cylinder. Two calibrated load cells were used to establish the magnitude of the applied forces.

Details of load cells are as follows:

Load cell	**PT**	**Ranger**
Serial No:	4137016	1344444
Capacity	10,000 kg	7,000 kg
Report Ref	ST4137016	V.AC/344-E-1
Calibration Organisation	PT Ltd	Australian calibrating Services (Aust) Pty Ltd
Calibration Date	2005	15th February 2005
Recording method	Data logging	Direct readout from digital scale

Based on the NSW Guidelines for suspension design and verification, the following load cases were selected as the target test loads:

4g vertical bump loads
1g vertical +/-0.6g lateral rut loads
2g vertical together with 1.2g braking load (use tyre diameter = 812 mm for calculation of brake torque)
2g vertical together with 2.5g overturning load
where g = static axle load = 2500 kg or 1250 kg/hub

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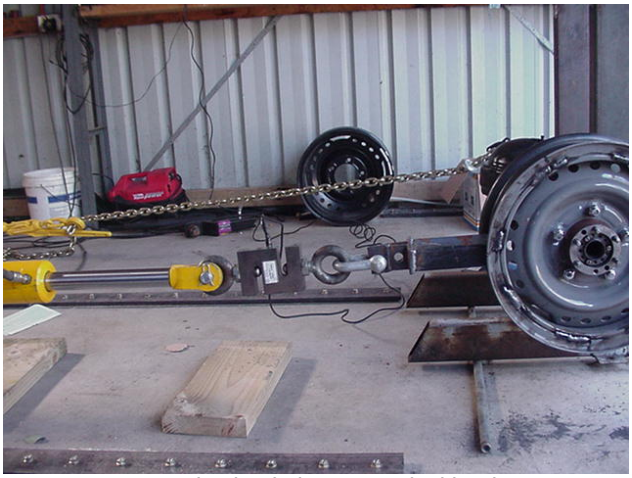
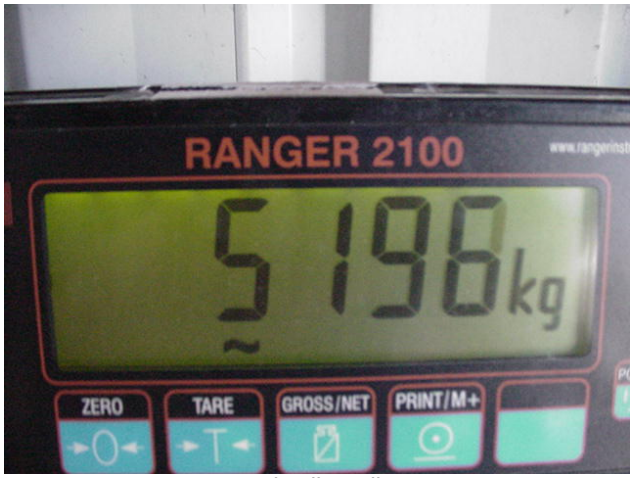
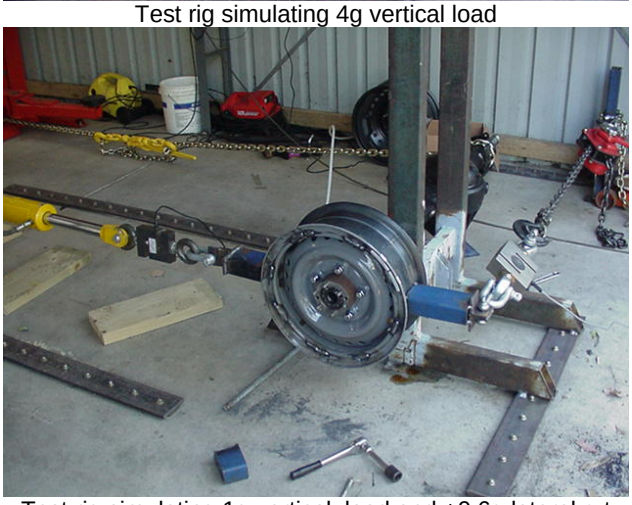
It was determined that should failure of any original equipment component occur prior to the test load being achieved, the hub and/or caliper mount should be regarded as satisfactory as their load capacity exceeds that of the original equipment components.



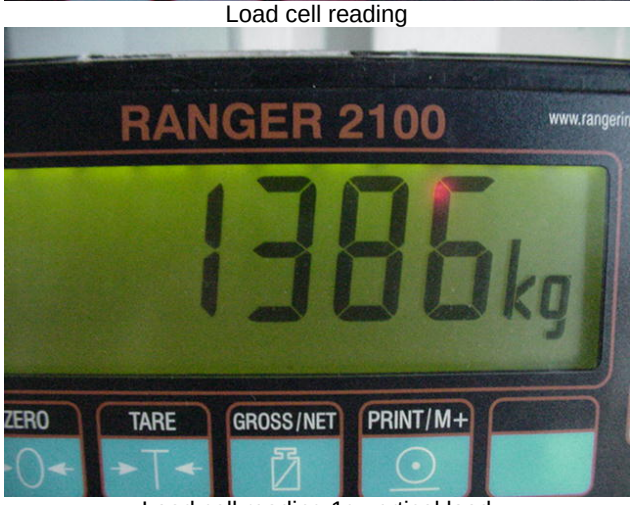
Test rig simulating 4g vertical load



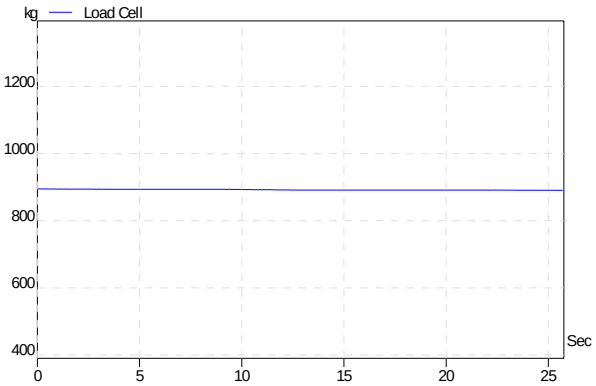
Load cell reading



Test rig simulating 1g vertical, load and +0.6g lateral rut load



Load cell reading 1g vertical load



Load cell readings 0.6g lateral load

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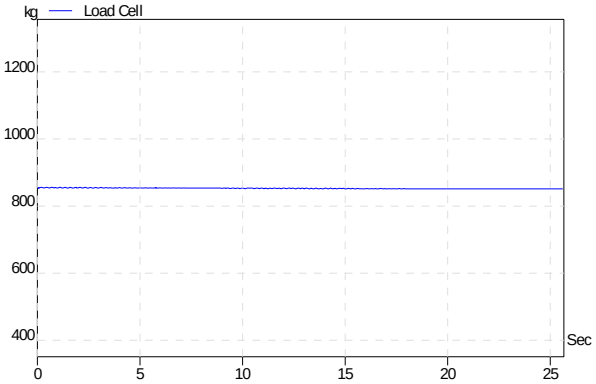
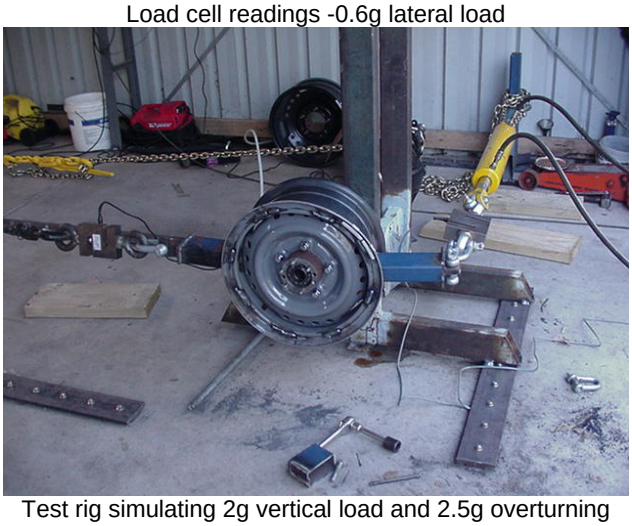
Test rig simulating 1g vertical, load and -0.6g lateral rut load

Load cell reading 1 g vertical load



Load cell readings -0.6g lateral load



Test rig simulating 2g vertical load and 2.5g overturning load (applied as lateral rut load

Vertical load imposed at time of failure of wheel rim due to overturning load

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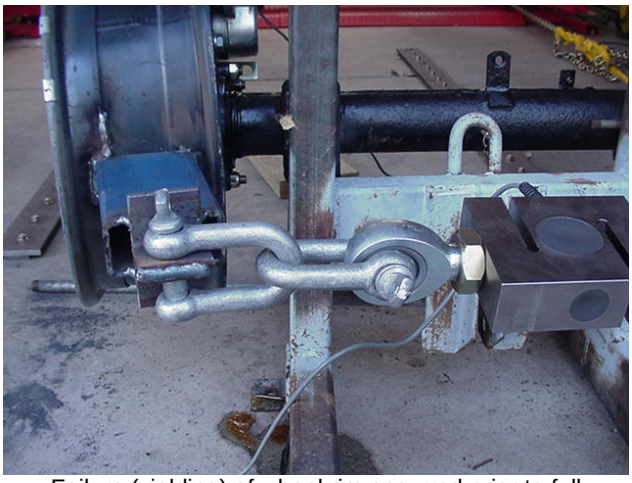
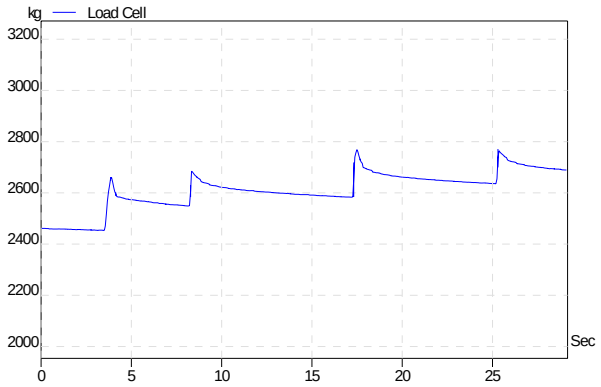
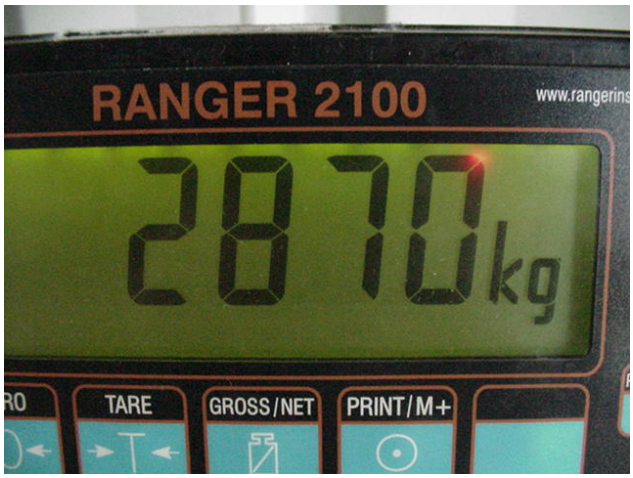


Failure (yielding) of wheel rim occurred prior to full overturning load being reached

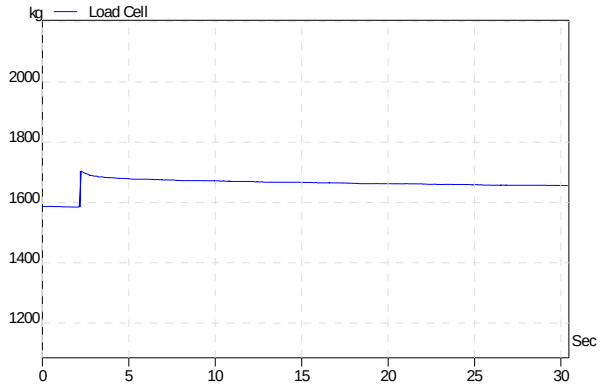


Load cell readings – overturning load applied at point representing tyre to road contact point.

Test rig simulating 2g vertical load and 1.2g braking load. Note that disc calliper and rotor assembly was pinned through the centre of the calliper piston to prevent rotation of the hub and brake disc assembly. This test also tests the strength of the calliper mounting bracket.



Load cell reading – 2g vertical load



Load cell readings – braking load

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Test Results

In each case, the load was applied progressively to establish the load at which cracking, separation of components or yielding occurred. The following measurements were recorded;

Test Mode	Target load	Applied load	Comments
4g vertical bump	5000 kg	5196 kg	Applied load exceeds target load. No cracking, separation, distortion or other failure observed.
1g vertical and +0.6g lateral rut load	1250 kg vertical 750 kg lateral rut	1386 kg vertical 894.6 kg lateral rut	Applied load exceeds target load. No cracking, separation, distortion or other failure observed.
1g vertical and -0.6g lateral rut load	1250 kg vertical 750 kg lateral rut	1770 vertical 856.1 kg lateral rut	Applied load exceeds target load. No cracking, separation, distortion or other failure observed.
2g vertical and 2.5g overturning load	2500 kg vertical 5363 kg overturning	1814 kg vertical 2769 kg overturning	Failure of the wheel rim occurred before full test load applied. Examination of brake and hub components revealed no evidence of cracking, separation, distortion or other failure.
2g vertical and 1.2g braking	2500 kg vertical 1500 kg braking	2870 kg vertical 1704.6 kg braking	Applied load exceeds target load. No cracking, separation, distortion or other failure observed.

Examination of Components Post-test

A dial indicator was used to measure disc runout which was found to be 0.7 mm at the perimeter of the disc and 0.3 mm at the pitch circle diameter of the wheel studs. While these figures are beyond those acceptable as recommended by the vehicle manufacturer, they were not of sufficient magnitude to cause any loss of function or effectiveness of the service brake system.

The calipers and mounting hardware, including fasteners were removed and visually inspected for damage. No damage was observed.

The tested hub was subjected to magnetic particle examination by a NATA laboratory. No evidence of cracking was observed. Refer accompanying report ref: R845/6.

Conclusion

Based on the above test results, it is concluded that the design of the conversion kits described in this report is such that they are safe and suitable for the intended application.

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Notes

Test results referred to in this report are applicable to the tested components only. The manufacturer is responsible for ensuring that all components conform to or exceed the specifications of the tested components in terms of physical size, type and physical properties of material, surface finish and fabrication/machining techniques. Any variation from the design which could affect the strength and/or durability of the installation will require validation by further testing and/or analysis.

The installer is responsible for ensuring that all fasteners used are of the correct grade and type and that they are tightened to the specified torque using a torque wrench of known accuracy. Where applicable, thread locking compound of the correct type is to be used. The installer must check to ensure that no fouling of components occurs at any extreme of suspension travel or steering movement.

Kevin C Williams MIEAust CPEng
VASS#1001

Date: 30th May 2005

Client: Hoppers Stoppers Pty Ltd
9 Nevada Court
Hoppers Crossing Vic 3029

Documents attached to and forming part of this report

- Weigh ticket 33019 showing mass of laden vehicle for laden brake test
- Report concerning field service testing of prototype vehicles
- Work instruction booklet
- Procedure for Toyota Landcruiser fitted with revised rear brakes and tailshaft mounted parking brake