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SEAT BELT ANCHORAGE TEST REPORT

REPORT REF No: 1146U

FOR A IN-VEHICLE
TEST TO DIRECTIVE 76/115/EEC
AS AMENDED BY 96/38/EC.

CONFIDENTIAL



**Manchester
Metropolitan
University**

1. Summary

Vehicle: Mercedes Vito

Company: Bernard Mansell Commercials

Test Standard: 76/115/EEC as amended by 96/38/EC

Tests conducted by: Richard Vernon Bsc (Hons).

Test date: 1st March 2006

Witnessed by: Mr. Steven Trenoweth, on behalf of the Vehicle Certification Agency.

Report prepared by: Chandramohan Mathavan

Report checked by: Michael Hughes BSc, C eng, MIMechE
STATUS Manager

Summary of results: The vehicle tested complied fully with the EC Directive.

2. Contents

1.	Summary	2
2.	Contents	3
3.	Definitions	4
4.	Requirements of Directive 76/115/EEC as amended by 96/38/EC	5
4.1.	Positional requirements	5
4.2.	Strength requirements	5
5.	Test Equipment	6
5.1.	The rig	6
5.2.	Instrumentation	6
5.3.	Monitoring Equipment	6
5.4.	Test Equipment Appraisal	6
6.	Test Vehicle / Structure	7
7.	Results	8
7.1.	Effective anchorage positions	8
7.2.	Test description	8
7.3.	Loads applied	8
7.4.	Loads held	8
7.5.	Condition of vehicle following test	9
8.	Conclusions	10
	Appendix 1 - Angular Requirements	11
	Appendix 2 - Load requirements	11
	Appendix 3 - 'H' point drawing	12
	Appendix 4 - Test log	15
	Appendix 5 - Pre-test photographs	16
	Appendix 6 - Post-test photographs	17
	Appendix 7 - Load graphs	19

3. Definitions

The Directive 76/115/EEC as amended by 96/38/EC shall hereafter be known as the Directive.

The three-dimensional 'H' point machine, used to determine 'H' points and torso angles, shall hereafter be known as the 'Manikin'.

The 'H' point is defined using the Manikin and corresponds to the pivot centre of the Manikin's torso and thigh (the hip).

The seating reference point, 'R' is defined by the vehicle manufacturer. Its coordinates must be within a square of size 50mm horizontally and 50mm vertically with the 'H' point at the centre of area.

The effective belt anchorage, or effective anchorage means the point to which a strap would need to be attached to provide the same lie as the belt when worn. (i.e. the last rigid guide which the belt touches before reaching its wearer). This is not necessarily where the seat belt bolts to the vehicle (the actual anchorage).

The 'S' distance is the distance between the effective upper belt anchorage and a plane parallel to the median longitudinal plane of the seat.

The STATUS seat belt anchorage test rig shall hereafter be known as the rig.

4. Requirements of Directive 76/115/EEC as amended by 96/38/EC

4.1. Positional requirements

The seating reference point, 'R' shall be determined according to Directive 77/649/EEC (Drivers Forward Visibility) as amended by 90/630/EEC using the Manikin constructed by the SAE to ISO Standard 6549 - 1980.

In order to comply with the Directive the following positional requirements shall be satisfied:

The anchorages must be suitable for attaching belts of the correct type.

The angles made between the horizontal and a line between the lower anchorages and the 'R' point must be within the limits specified by the Directive, for the seat. (See Appendix 1).

The separation of the lower anchorages must be greater than or equal to the limit set by the Directive (350mm for all seats).

The distance of each lower anchorage from the median longitudinal plane of the seat must be greater than or equal to the limit set by the Directive (120mm for all seats).

The 'S' distance must be greater than or equal to the limit set by the Directive (140mm).

The effective upper anchorage must lie in a zone constructed according to the Directive depending on the 'R' point, torso angle and 'S' distance.

4.2. Strength requirements

The seat belt anchorages shall be subjected to tractive forces in a forward direction at an angle of 5° to 15° above the horizontal, in a plane parallel to the median longitudinal plane of the vehicle. The forces shall be transmitted using traction devices, as described in the Directive.

If one or more of the seat belt anchorages are attached to the structure of the seat, an additional load shall be added according to the weight of the seat and a factor defined in the Directive. The required loads and factors are shown in Appendix 2.

The anchorages must withstand this load for not less than 0.2 seconds. Partial failure shall not constitute a failure provided that the minimum requirements for separation of the lower anchorages, and height of upper anchorage are maintained.

5. Test Equipment

5.1. The rig

The rig used was a free standing structure with horizontal beams that could be moved into appropriate positions in order to clamp down the vehicle. A total of ten hydraulic rams were fitted to a carrier of which only six were required for the test. The rams were provided with a means vertical and horizontal position adjustment as well as having angular freedom in a vertical plane parallel to the longitudinal plane of the rig.

5.2. Instrumentation

Loads were measured using load cells with full bridge strain gauges, which were calibrated using an Instron 8500 dynamic testing machine (Serial No: 8500 H1715), with calibration traceable to primary standards. Voltage outputs were sampled at a rate of 100Hz through a data acquisition card to a computer. These voltages were buffered and then used to generate load against time graphs using the calibration factors previously obtained.

5.3. Monitoring Equipment

The testing was monitored visually and recorded on video. 'Before and after' still photographs were taken using a digital camera.

5.4. Test Equipment Appraisal

The test equipment is appraised to perform tests to EC directive 76/115/ECE as amended by the Vehicle Certification Agency

6. Test Vehicle / Structure

The vehicle submitted for testing was Mercedes Vito LWB taxi adaptation. The vehicle had two front doors, two side sliding doors and rear tailgate.

The vehicle configuration consisted of a dividing bulkhead which was fitted behind the drivers and front passenger seats. The bulkhead was secured to the vehicle's floor via 5x M8 bolts and associated rivnuts. Two additional brackets, riveted to the B-posts and utilising one M8 bolt per side, secured the top of the bulkhead.

A row of three reverse facing tip-up seats were fixed to the bulkhead. The seats were configured for 3 point seat belts and none of the seat belt anchorages were on the seat structures, they were all fastened to the bulkhead.

A space for a reverse facing wheelchair was located between the B & C pillars. The wheelchair rear restraints were fixed to the lower bulkhead such that the rear of the wheelchair would butt up against the bulkhead and use the left hand reverse tip-up Upper and LNB seat belt anchorage in conjunction with the middle tip-up seat's LB anchorage.

Refer to the pre-test photographs shown in Appendix 5.

7. Results

7.1. Effective anchorage positions

A drawing showing the position of the 'H' point in relation to the effective belt anchorages, with regard to the requirements, is shown in appendix 3.

7.2. Test description

The following list includes details of the tests undertaken with reference to the test number.

1146_2292 -Test of row of three bulkhead mounted reverse facing tip-up single seats to standards laid down for M1 category. (M3 for reverse facing seats)

1146_2293 - Test of the reverse facing wheelchair restraints using a surrogate wheelchair in the reverse direction to loads based on Motability standards for forward facing wheelchairs.

See Appendix 4 for complete test log.

7.3. Loads applied

The additional applied loads were derived by multiplying the seat weight (declared or measured) by 9.81 and a weight factor of 20. This was then added to the lap belt load as specified in the directive (See appendix 2) to produce the loads shown in the following table:

Test Reference	Load applied to each traction device	Results Filename
1146_2292	4.5 kN (lap belt) 4.5 kN (diagonal belt)	1146_2292.res
1146_2293	11.10kN(wheelchair)	1146_2293.res

7.4. Loads held

The loads held were as shown in the graphs found in Appendix 7:

7.5. Condition of vehicle following test

Following each test the vehicle was visually examined; during this examination the condition of the vehicle and components were noted. The examination results in the following observations:

1146_2292 - Slight bowing across the top of the bulkhead. Slight further deformation on slotted holes.

1146_2293 - Bulkhead metal directly adjacent to M10 bolts showed deformation with loosening of bulkhead to floor rivnut.

Post-test photographs are shown in Appendix 6.

8. Conclusions

The vehicle seat belt anchorages tested complied with the positional requirements of Directive 76/115/EEC (as amended up to and including 96/38/EC) as demonstrated by the drawing in Appendix 3.

The vehicle seat belt anchorages tested complied with the strength requirements of Directive 76/115/EEC (as amended up to and including 96/38/EC) as shown in the graphs in Appendix 7.

The wheelchair chair restraints complied with the Motability requirements for forward facing wheelchairs applied to the rear restraints of a reverse facing wheelchair in the reverse direction.

Appendix 1 - Angular Requirements.

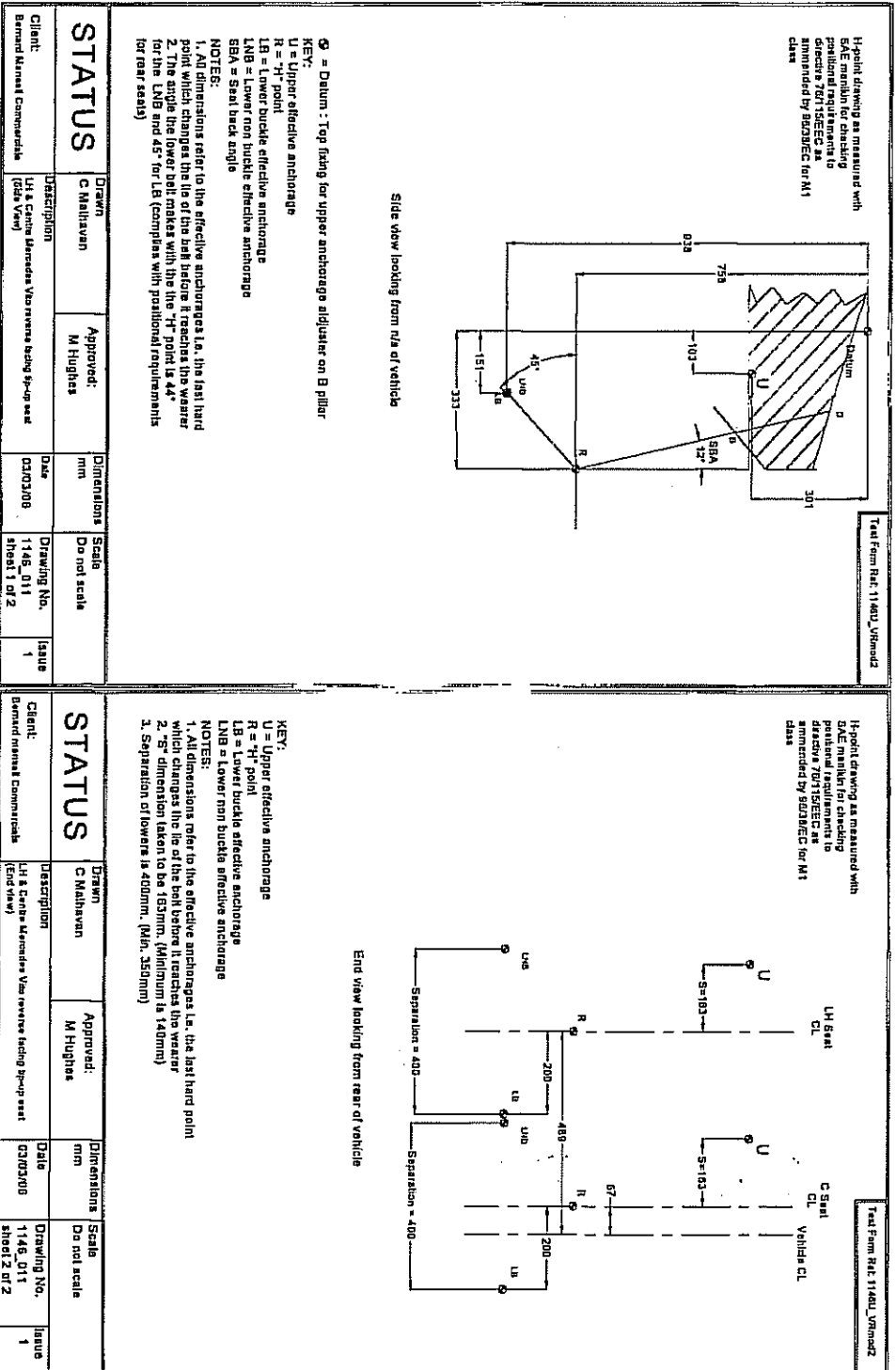
Seat		M1	M2 & M3
Front	buckle side (α_2)	45°-80°	30°-80°
	other than buckle side (α_1)	30°-80°	30°-80°
	angle constant	50°-70°	50°-70°
	bench - buckle side (α_2)	45°-80°	20°-80°
	bench other than buckle side (α_1)	30°-80°	20°-80°
	adjustable seat with back angle <20°	45°-80° (α_2) 20°-80° (α_1)	20°-80°
Rear		30°-80°	45°-90°
Folding	No belt required. If anchorage fitted: see angle requirements Front and Rear		

Appendix 2 - Load requirements.

Category	Load per ram 3-point	Load - lap belt	Weight of seat factor
M1	13.5kN	22.25kN	20
M2	6.75kN	11.10kN	10
M3 or rearward facing	4.5kN	7.40kN	6.6

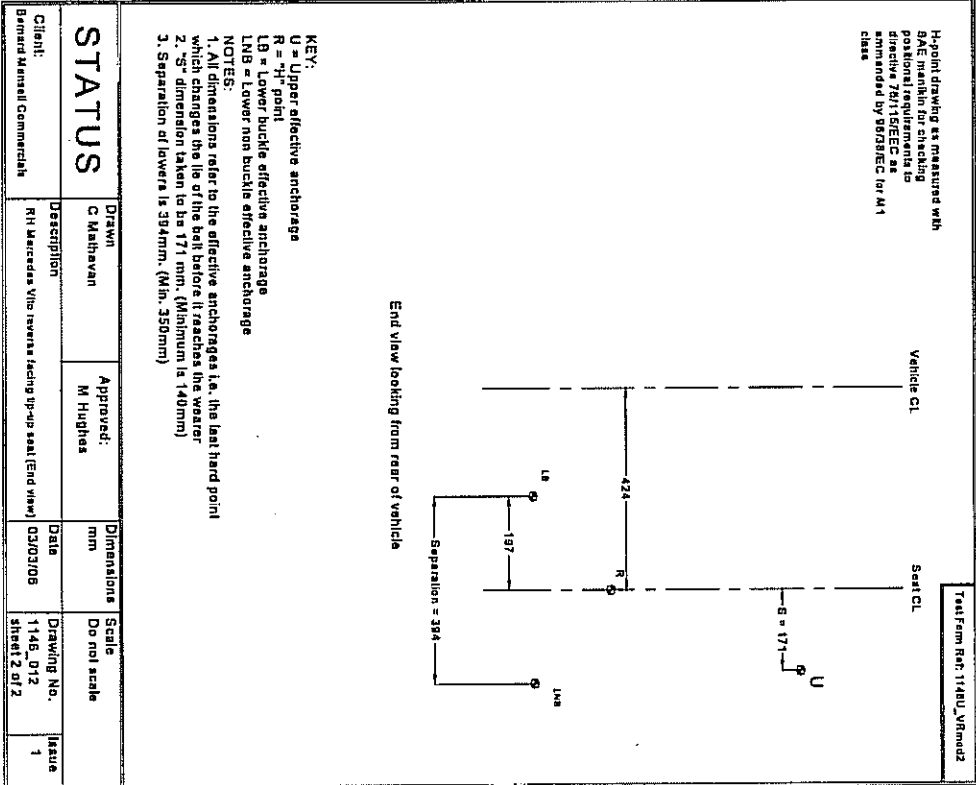
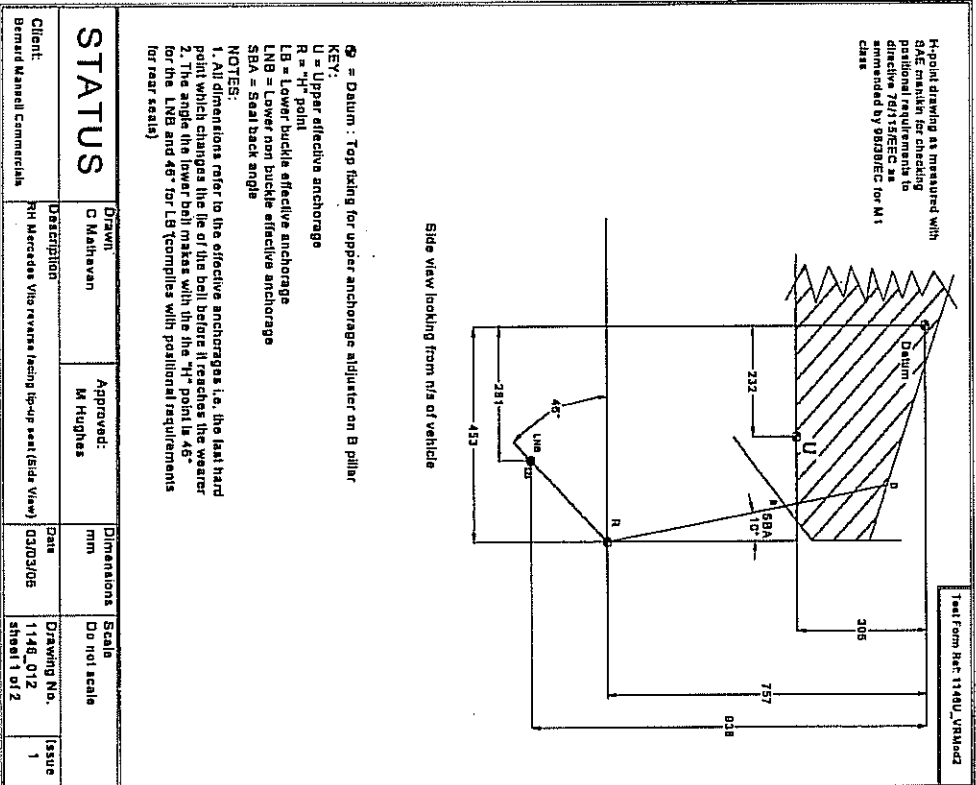
Appendix 3 - 'H' point drawing.**Drawings Supplied:**

Drawing Number	Title
1146_011	LH & Centre Mercedes Vito reverse facing tip-up seat
1146_012	RH Mercedes Vito reverse facing tip-up seat



STATUS	Drawn	Approved:	Dimensions	Scale
	C Mallawaan (Old View)	M Hughes	mm	Do not scale
Client:	Description	Date	Drawing No.	Issue
Bernard Marshall Commercials	LH & Centre Mercedes Vito reverse facing 3p-2 seat (Old View)	03/03/08	1146_U_011	1
	Sheet 1 of 2			

STATUS	Drawn	Approved:	Dimensions	Scale
	C Mallawaan (End View)	M Hughes	mm	Do not scale
Client:	Description	Date	Drawing No.	Issue
Bernard Marshall Commercials	LH & Centre Mercedes Vito reverse facing 3p-2 seat (End View)	03/03/08	1146_U_011	1
	Sheet 2 of 2			



Appendix 4 – Test log.

Test number	Date	Manufacturer ref.	Seat Description and test observation	Leg Separation (mm)	Leg Height F/R (mm)	Weight (kg)	Trip load (kN) Lower	Trip load (kN) Upper	Result (Pass/Fail)	Single/Double/Triple	M1/M2/M3	3 pt / lap / harness	Results Filename
2292	01/03/06	1146	Mercedes Vito LWB. Mercedes Vito with bulkhead section .2 x M8 bolts with penny washers located through slotted brackets locating top of bulkhead. B-post adapters riveted to B-post. 5 x M8s (into star rivets into floor) locating bulkhead to floor. No SBAs were on the seats themselves. Very slight further deformation of slotted holes. Slight bowing across the bulkhead top.	n/a	n/a	n/a	4.50	4.50	Pass	3	M3	3pt	1146_2292.RES
2293	01/03/06	1146	Mercedes Vito LWB. Mercedes Vito with bulkhead section .2 x M8 bolts with penny washers located through slotted brackets locating top of bulkhead. B-post adapters riveted to B-post. 5 x M8s (into star rivets into floor) locating bulkhead to floor. The two rear front cabin mounted struts were removed for this test. Wheel-chair front tie downs fastened into bulkhead. Metal directly adjacent to M10 bolts showed deformation with loosening of directly adjacent bulkhead to floor tie-rod	n/a	n/a	n/a	11.10	0.00	Pass	1	M2	1	1146_2293.RES

Appendix 5 - Pre-test photographs.

Figure 5.1 – Vehicle on test rig.



Figure 5.2 - Test 1146 2292

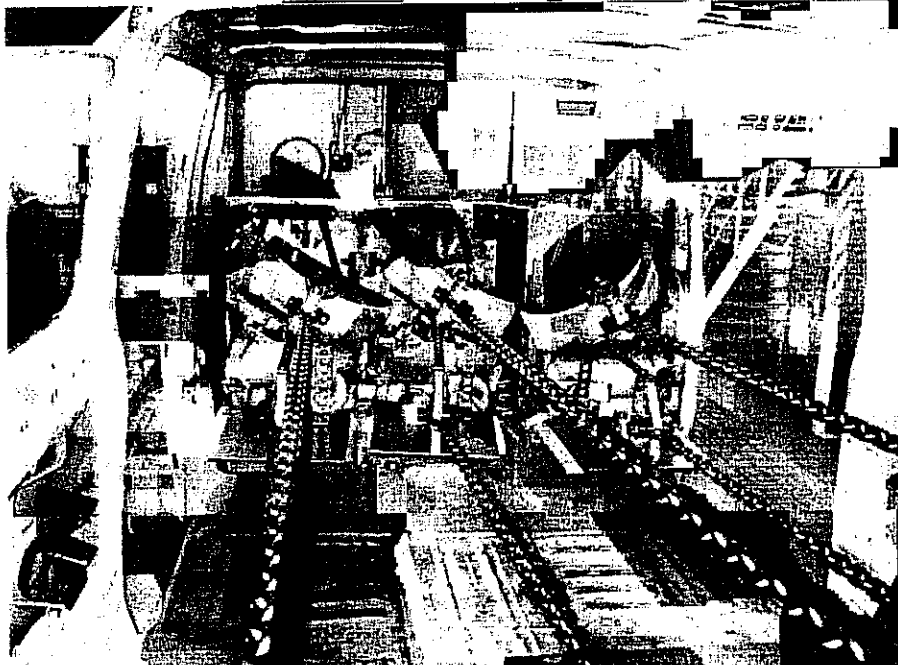
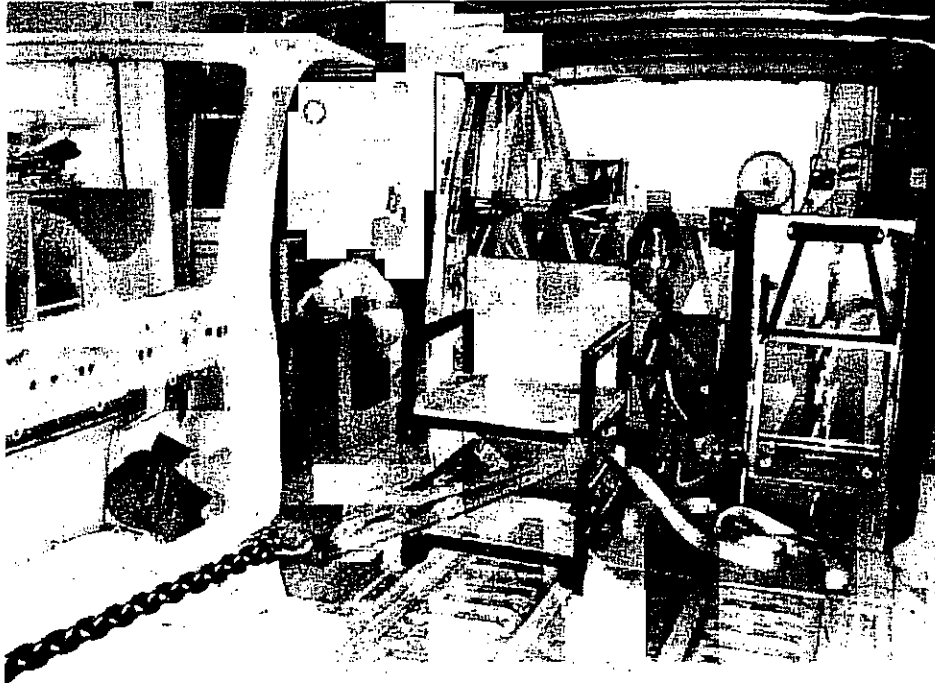


Figure 5.3 - Test 1146_2293



Appendix 6 - Post-test photographs.

Figure 6.1 - Test 1146 2292

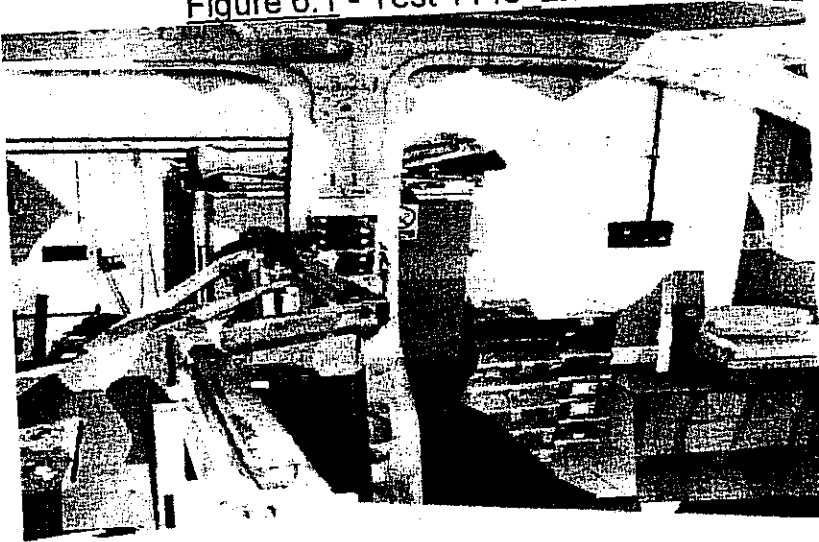
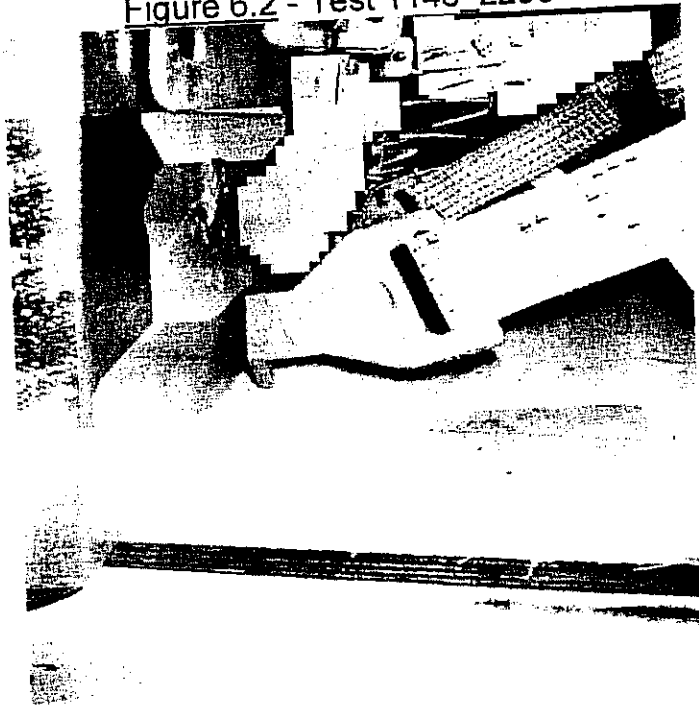


Figure 6.2 - Test 1146 2293



Appendix 7 - Load graphs.

Graph Channel Key

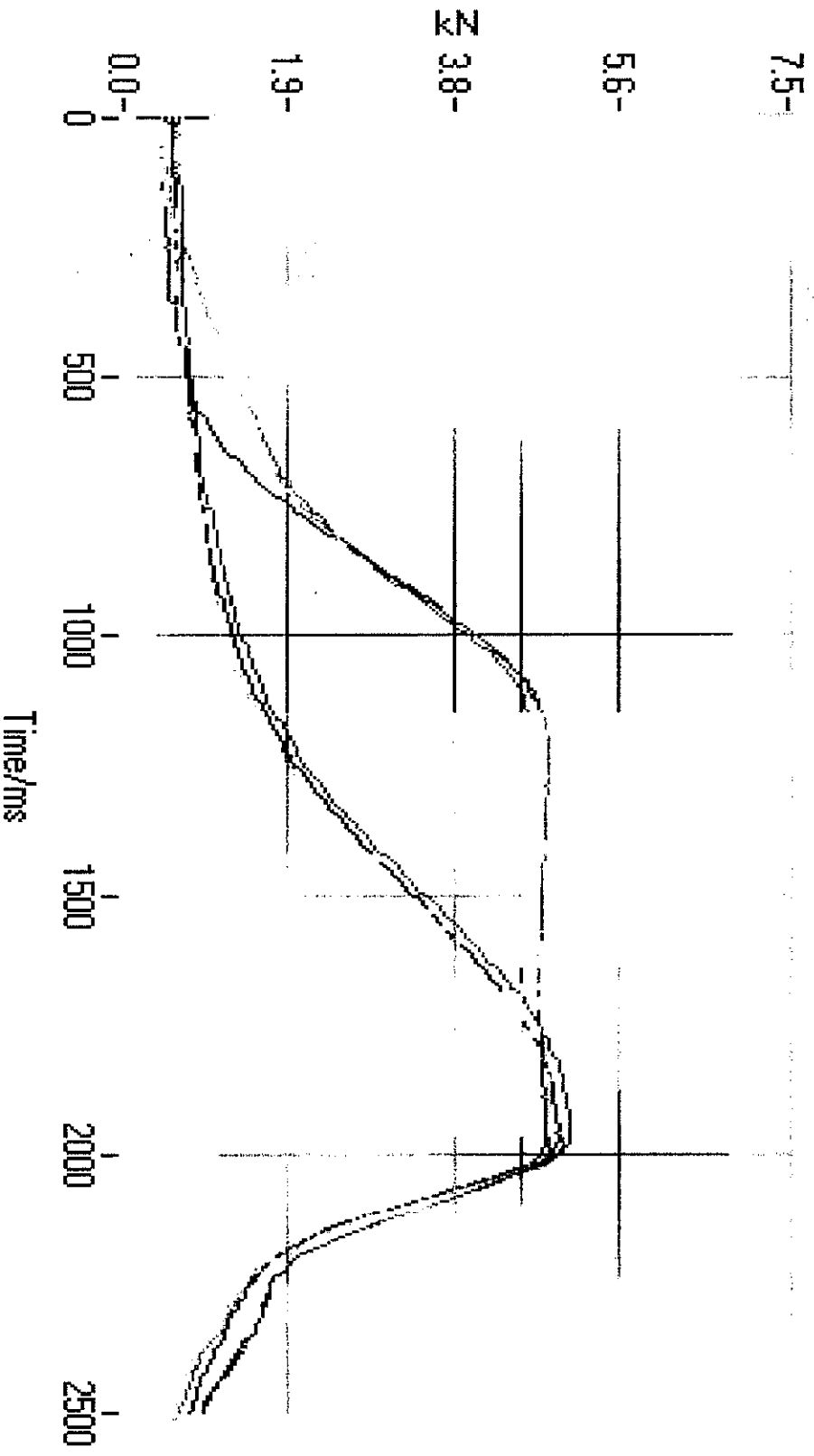
Lower Rams		Upper rams	
Channel Number	Colour	Channel Number	Colour
1	○	2	●
3	●	4	●
5	○	6	○
7	○	8	●
9	●	10	●

Test Channel Allocation

Test Ref	Load Position	Channel Number		
		Seat Position		
		LHS	Centre	RHS
1146_2292	Diag	4	6	8
	Lap	3	5	7
1146_2293	W/chair	3	-	-

Test Reference: 1146_2292

Test Details: Test of first row of seats to M1 (M3 load for reverse facing seats)



Test Reference: 1146_2293

Test Details: Test of wheelchair front tie-downs to Mobility standards(reverse direction)

