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## SEAT BELT ANCHORAGE TEST REPORT

REPORT REF No: 1146T

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

CONFIDENTIAL



Manchester  
Metropolitan  
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## 1. Summary

**Vehicle:** Volkswagen T5 Taxi Adaptation.

**Company:** Bernard Mansell Commercials

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

**Tests conducted by:** Richard Vernon Bsc (Hons).

**Test date:** 31/03/2005

**Witnessed by:** James Eccleston on behalf of the Vehicle Certification Agency.

**Report prepared by:** Firasse Ahmed

**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

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### 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 Volkswagen T5 taxi adaptation. The vehicle had two front doors, two side sliding doors and rear tailgate.

In the first vehicle configuration a dividing bulkhead was fitted behind the drivers and front passenger seats. The bulkhead was secured to the vehicle's floor via bolts through the floor, two brackets fastened to the vehicle B pillar via one M8 bolt and star rivnut for each pillar and a diagonal support fixed to the passenger floor via 3 M8 bolts and rivnuts.

The first row of seats was three reverse facing tip-up seats. The seats were fixed to the bulkhead. None of the seat belt anchorages were on the seats structure, 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 bulkhead such that the rear of the wheelchair would butt up against the bulkhead and use the middle reverse tip-up seat seat belt as the wheelchair occupant restraint.

In the second vehicle configuration, the bulkhead was replaced with six lengths of Koller heavy duty tracking. The tracking pair separation was 500mm.

The second row of seats was three Bernard Mansell reverse facing tip-up seats. The seats were located near the B pillar. The seats were bolted through the tracking and the vehicle floor via four M10 bolts (no lockables)

The second wheelchair space was for a forward facing wheelchair secured to the floor via two front and two rear Slide 'n' Click Q'Straint fixings. The arrangement at the front and rear restraints was identical in terms of location into the vehicle floor. The rear restraints also provided the lower occupant restraints in lap only configuration.

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\_2097 Test of first row of reverse facing bulkhead mounted seats was tested to standards laid down for M1 category (M3 load for reverse facing seats).
- 1146\_2098 Test of the reverse facing wheelchair rear restraints in bulkhead to standards based on Motability standards.
- 1146\_2099 Test of second row of reverse facing Bernard Mansell seats was tested to standards laid down for M1 category (M3 load for reverse facing seats).
- 1146\_2101 Test simulation of the forward facing Q straint wheelchair rear & occupant restraint (Lap configuration) with loads applied in the rear direction to standards based on Motability standards.

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_2097      | 4.50 kN (lap belt)<br>4.5 KN (diagonal belt) | 1146_2097.res    |
| 1146_2098      | 11.10 KN (W/chair)                           | 1146_2098.res    |
| 1146_2099      | 4.50 kN (lap belt)<br>4.5 KN (diagonal belt) | 1146_2099.res    |
| 1146_2101      | 44.5 KN (W/chair)                            | 1146_2101.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\_2097 Deformation of B-pillars adjacent to star rivnuts most noticeable on LHS pillar with 'legs' of rivnut just starting to show through drilled attachment hole.
- 1146\_2098 No discernible damage to bulkhead structure
- 1146\_2099 Slight loosening of base with front legs primarily pushing down on front base bar.
- 1146\_2101 Floor pulled up directly adjacent to Q'straint fixings.

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 reverse facing wheelchair rear restraints complied with the strength requirement based on Motability standards in the reverse direction.

The forward facing wheelchair rear restraints complied with the strength requirements based on Motability standards in the forward direction when simulated in the reverse direction.

The forward facing wheelchair occupant restraints in lab configuration complied with the strength requirements based on Motability standards in the forward direction when simulated in the reverse direction.

**Appendix 1 - Angular Requirements.**

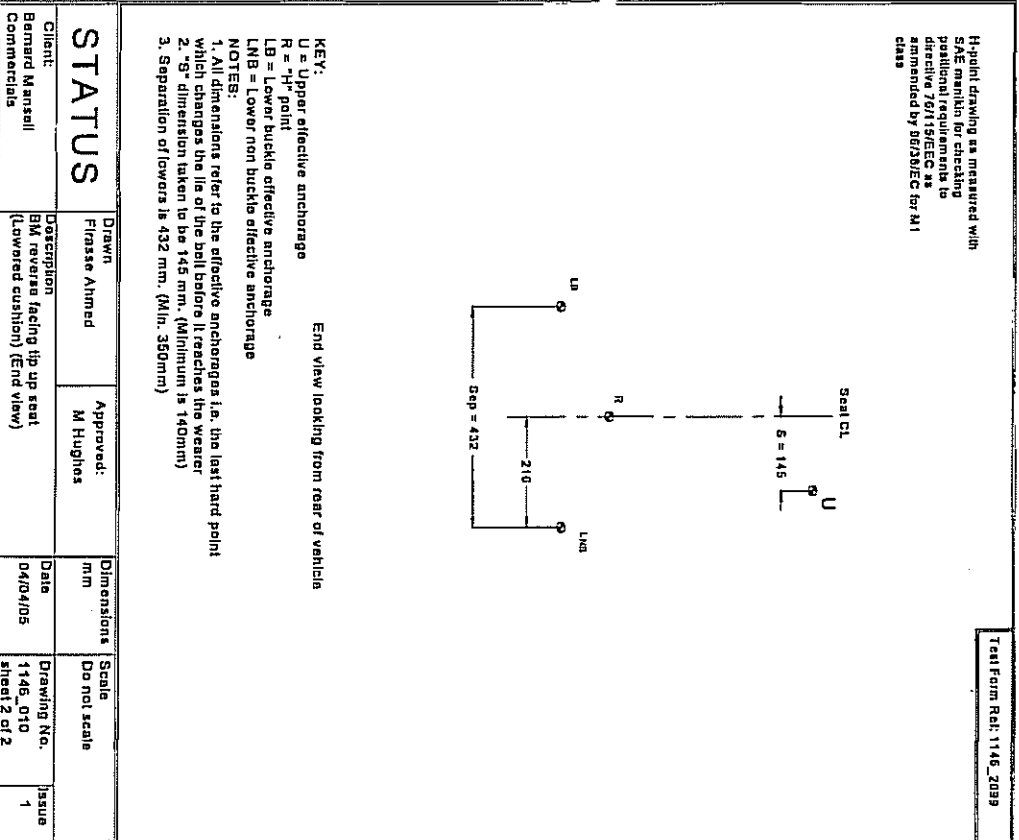
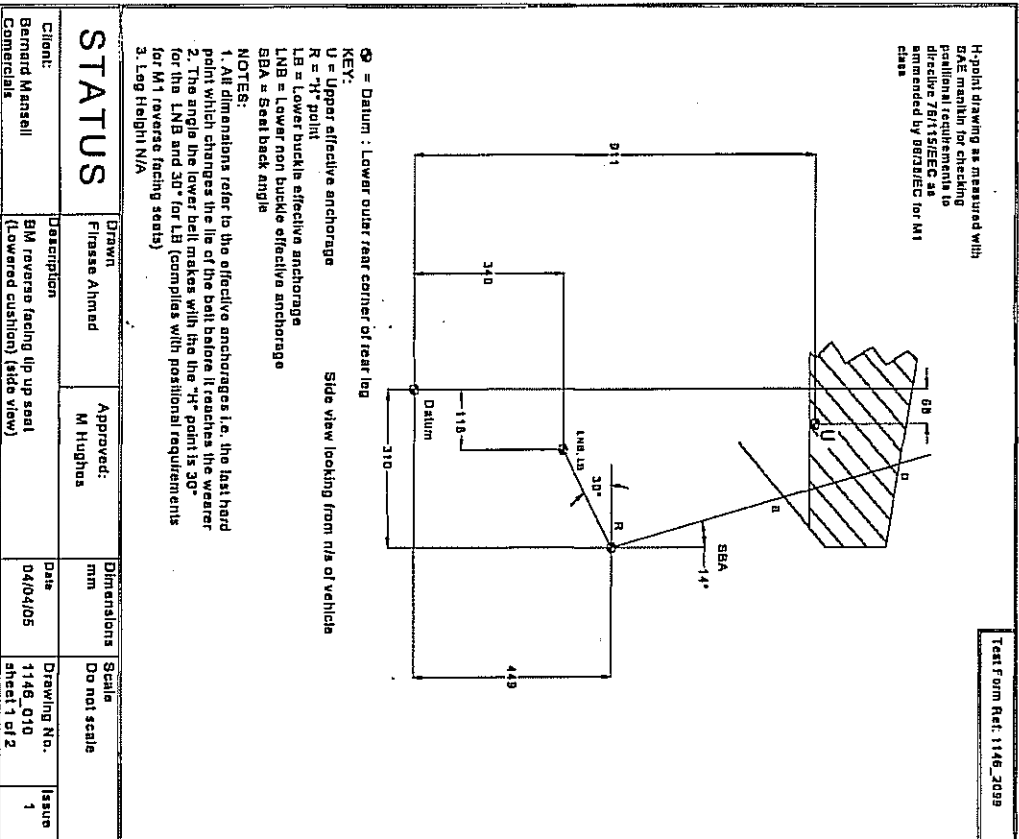
| Seat    |  | M1   | M2 & M3 |
|---------|--|--|---------|
| Front   | buckle side ( $\alpha_2$ )   | 45°-80°  | 30°-80° |
|         | other than buckle side ( $\alpha_1$ )  | 30°-80°  | 30°-80° |
|         | angle constant   | 50°-70°  | 50°-70° |
|         | bench - buckle side ( $\alpha_2$ )   | 45°-80°  | 20°-80° |
|         | bench other than buckle side ( $\alpha_1$ )                                  | 30°-80°  | 20°-80° |
|         | adjustable seat with back angle <20°   | 45°-80° ( $\alpha_2$ )<br>20°-80° ( $\alpha_1$ ) | 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:**

| <b>Drawing Number</b> | <b>Title</b>                                     |
|-----------------------|--|
| 1146_009              | Reverse facing bulhead mounted tip-up seat       |
| 1146_010              | B M reverse facing tip up seat (Lowered cushion) |



Test Form Ref: 1146\_2006

H-point drawing as measured with SAE manikin for checking positional requirements to directive 76/115/EEC as amended by 80/13/EEC for M1 class.  
 The H point was redefined from downward for the upper anchorage to achieve compliance

Side view looking from side of vehicle

● = Datum : Actual lower buckle anchorage  
 KEY:  
 U = Upper effective anchorage  
 R = "H" point  
 LB = Lower buckle effective anchorage  
 LNB = Lower non buckle effective anchorage  
 SBA = Seat back angle

NOTES:  
 1. All dimensions refer to the effective anchorages i.e. the last hard point which changes the lie of the belt before it reaches the wearer  
 2. The angle the lower belt makes with the the "H" point is 35° for the LNB and 35° for LB (complies with positional requirements for M1 rear seats)  
 3. Leg Height N/A

|  |   |           |                  |   |       |
|--|---|-----------|------------------|---|-------|
| <b>STATUS</b>                            | Drawn   | Approved: | Dimensions       | Scale                                   | Issue |
|  | Firasse Ahmed   | M Hughes  | mm               | Do not scale                            | 1     |
| Client:<br>Bernard Mansell<br>Commercial | Description<br>Reverse facing bulkhead mounted tip up seats (side view) |           | Date<br>29/03/05 | Drawing No.<br>1146_009<br>sheet 1 of 2 |       |

Test Form Ref: 1146\_2006

H-point drawing as measured with SAE manikin for checking positional requirements to directive 76/115/EEC as amended by 80/13/EEC for M1 class

End view looking from rear of vehicle

KEY:  
 U = Upper effective anchorage  
 R = "H" point  
 LB = Lower buckle effective anchorage  
 LNB = Lower non buckle effective anchorage

NOTES:  
 1. All dimensions refer to the effective anchorages i.e. the last hard point which changes the lie of the belt before it reaches the wearer  
 2. "S" dimension taken to be 170 mm. (Minimum is 140mm)  
 3. Separation of lowers is 386 mm. (Min. 350mm)

|  |  |           |                  |   |       |
|--|--|-----------|------------------|---|-------|
| <b>STATUS</b>                            | Drawn  | Approved: | Dimensions       | Scale                                   | Issue |
|  | Firasse Ahmed  | M Hughes  | mm               | Do not scale                            | 1     |
| Client:<br>Bernard Mansell<br>Commercial | Description<br>Reverse facing bulkhead mounted tip up seats (End view) |           | Date<br>29/03/05 | Drawing No.<br>1146_009<br>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 Destruct | 3 pt / lap / harness | Results Filename |
|-------------|-------------|-------------------|---|---------------------|---------------------|-------------|----------------------|----------------------|--------------------|----------------------|-------------------|----------------------|------------------|
| 2097        | 21 Mar 2005 | 1146              | Volkswagen T5. Single nut and bolt taken from support bar base plate 3 x reverse facing tip-ups (GM version) on fabricated bulkhead. No anchorages on seat itself - all on bulkhead. Further deformation of B-pillars adjacent to star rivnuts, most noticeable on LHS pillar with 'legs' of rivnut just starting to show through drilled attachment hole                           | n/a                 | n/a                 | 0.00        | 4.50                 | 4.50                 | Pass               | 3                    | M3                | 3p3p3<br>p           | 1146_2097.RES    |
| 2098        | 21 Mar 2005 | 1146              | Volkswagen T5. Reverse facing wheelchair restraints. Note intended upper for occupant would be through bulkhead ie already tested. No discernible damage to bulkhead structure  | n/a                 | n/a                 | 0.00        | 11.10                | 0.00                 | Pass               | 1                    | M2                | 1                    | 1146_2098.RES    |
| 2099        | 21 Mar 2005 | 1146              | Volkswagen T5. 3 x reverse facing tip-ups (BM version) Seats sit in Keller heavy duty tracking. 4 x M10s used to fasten seats to twin tracking, seat base front base bar 2250mm from rear of vehicle. tracking pairs separated by 500mm. Seats bolted through tracking and floor ie NO lockables. Slight loosening of base with front legs primarily pushing down on front base bar | n/a                 | n/a                 | 20.45       | 5.82                 | 4.50                 | Pass               | 3                    | M3                | 3p3p3<br>p           | 1146_2099.RES    |
| 2101        | 21 Mar 2005 | 1146              | Volkswagen T5. Reverse facing wheelchair restraints. Qstraint 'mushrooms' replicating forward pull ie same arrangement respective to under-floor beam Floor pulled up directly adjacent to Qstraint fixings   | n/a                 | n/a                 | 0.00        | 22.25                | 0.00                 | Pass               | 2                    | m1                | 11                   | 1146_2101.RES    |

Appendix 5 - Pre-test photographs.

Figure 5.1 – Vehicle on test rig.

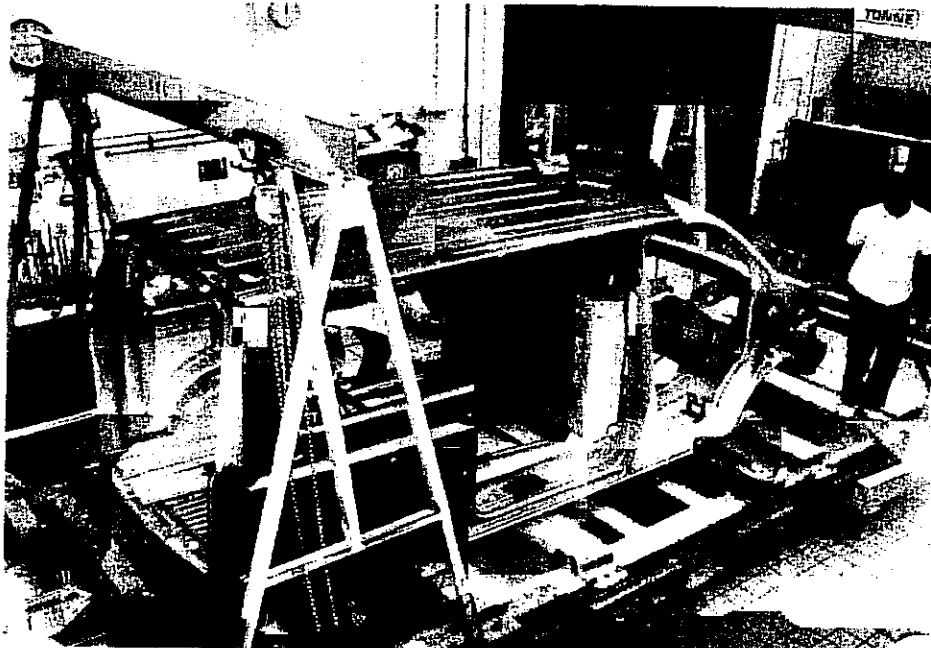


Figure 5.2- 1146\_2097 Pre test picture

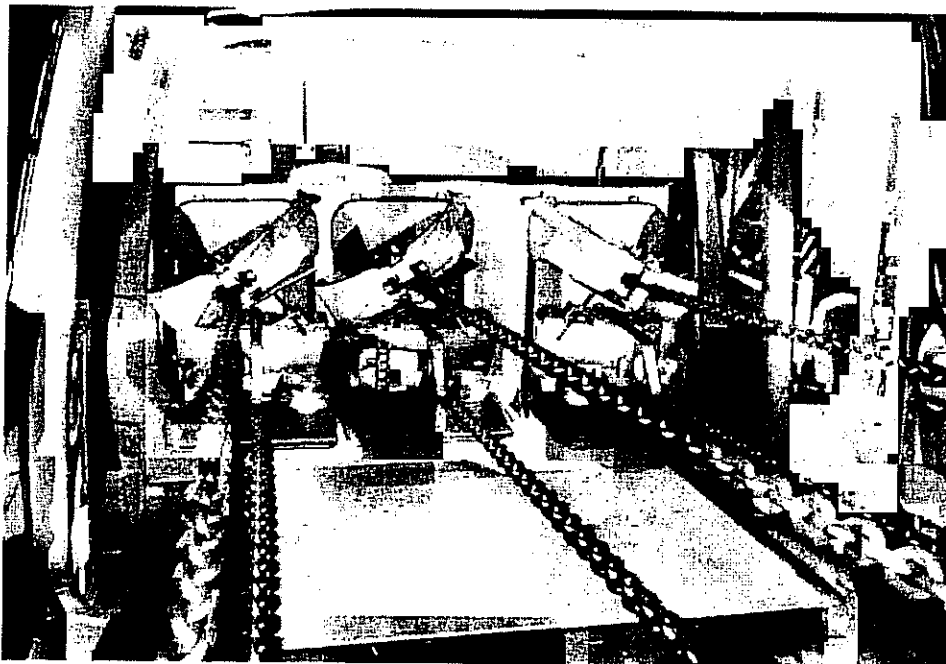




Figure 5.3- 1146\_2098 Pre test picture

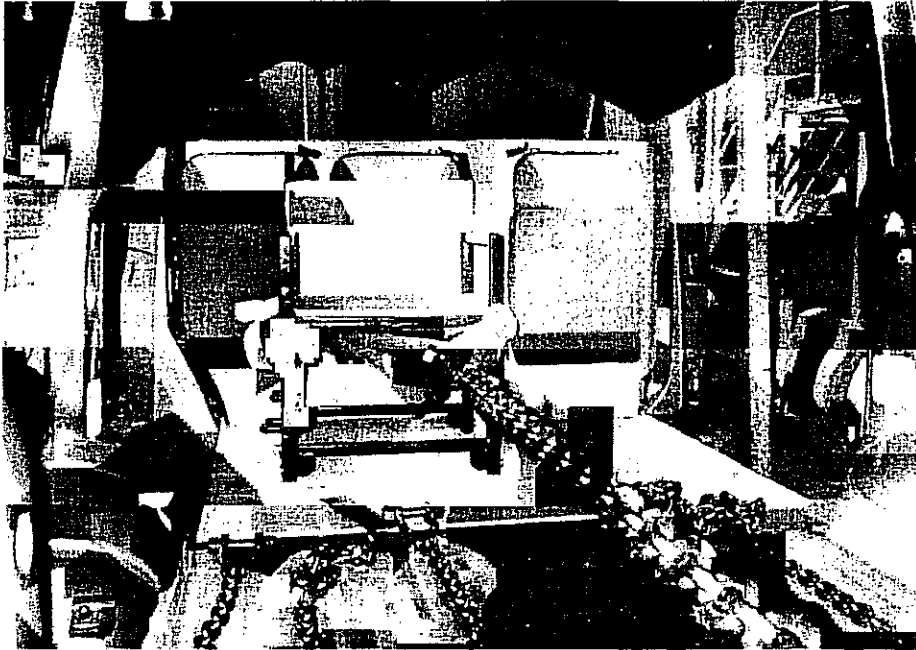


Figure 5.4- 1146\_2099 Pre test picture

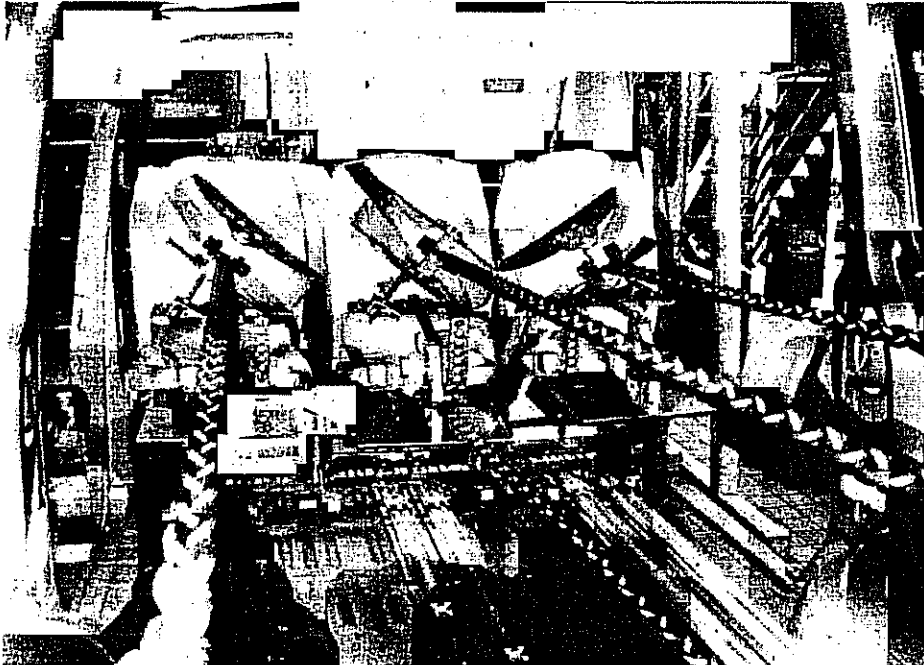
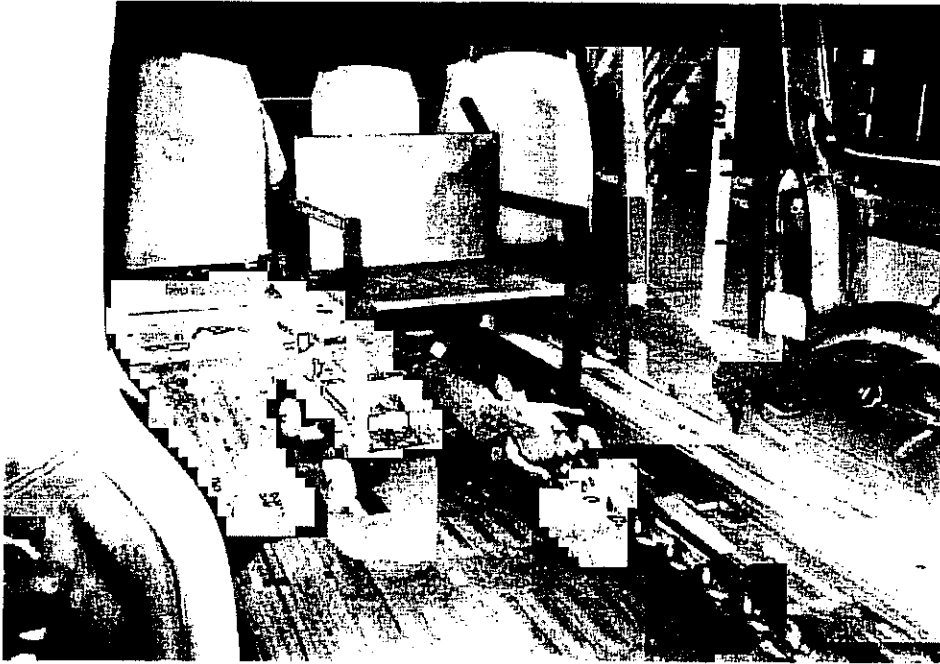


Figure 5.5- 1146\_2101 Pre test picture



Appendix 6 - Post-test photographs.

Figure 6.1- 1146\_2097 Post test picture

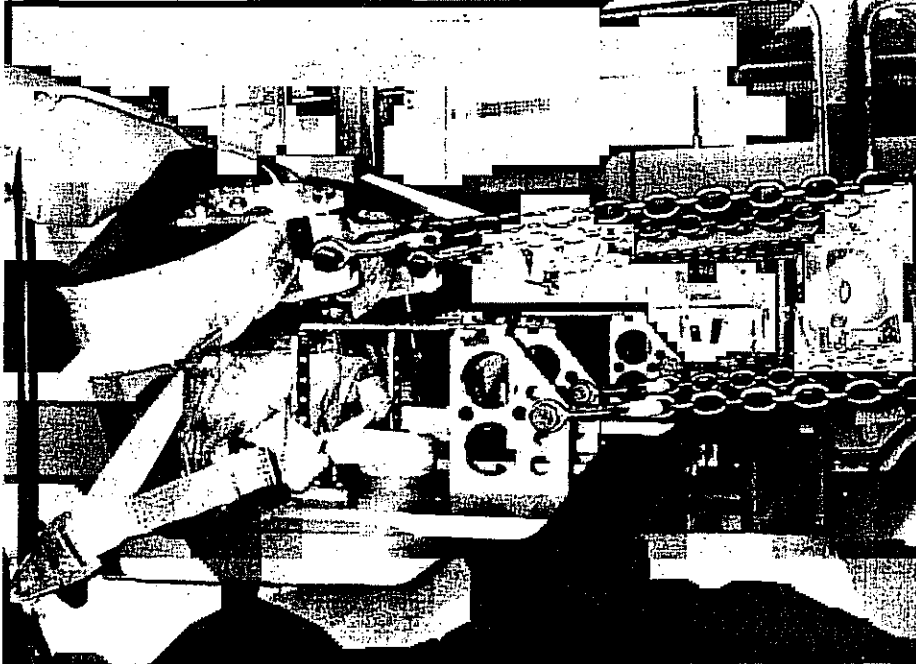


Figure 6.2- 1146\_2098 Post test picture

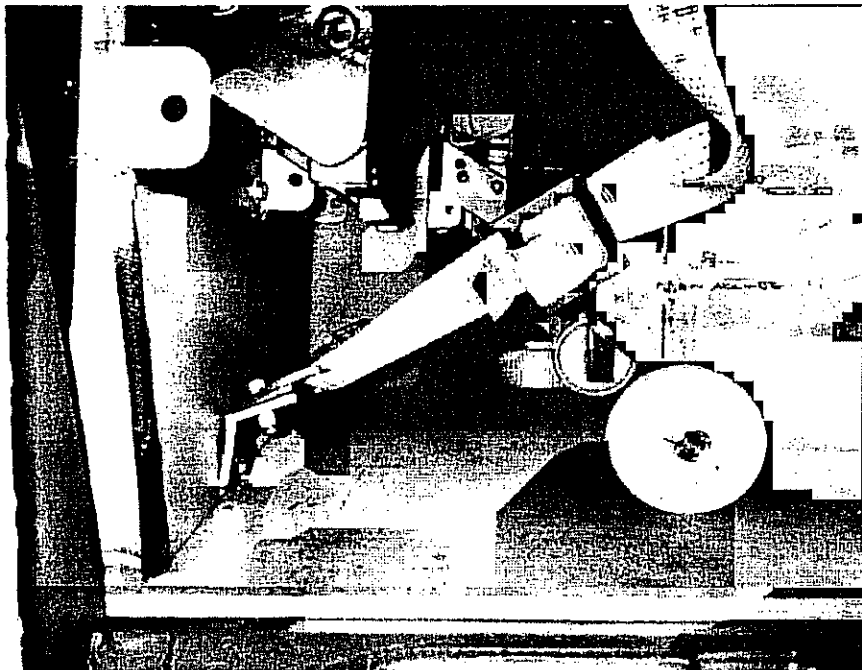


Figure 6.3- 1146\_2099 Post test picture

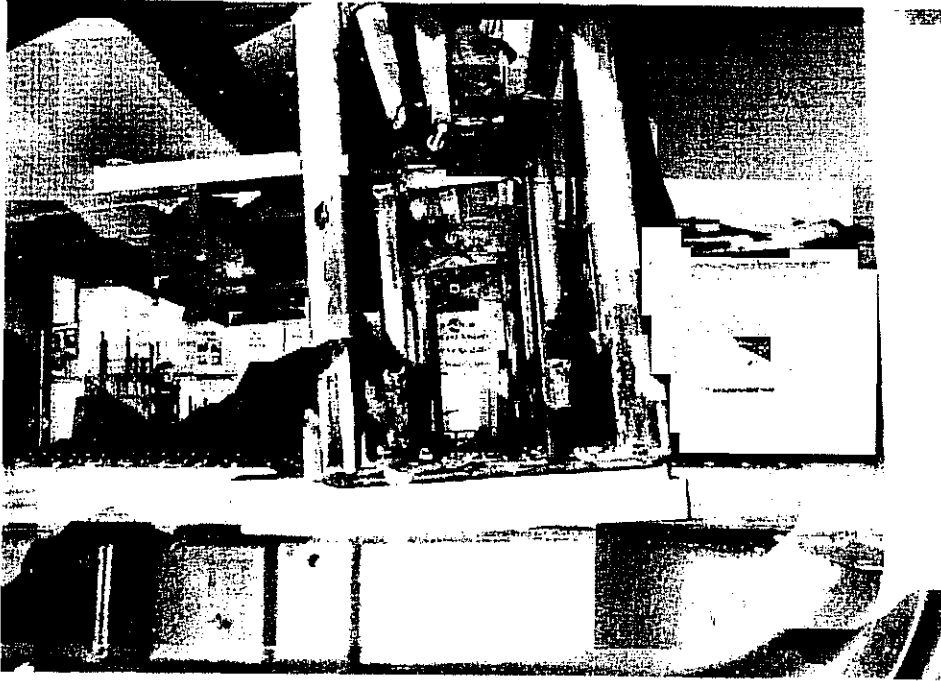
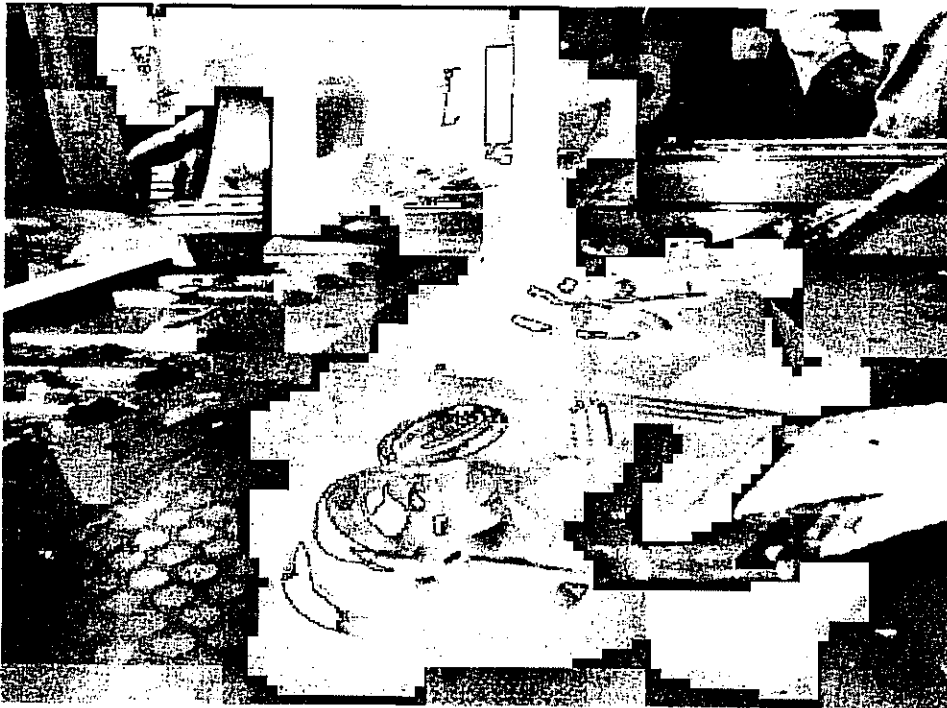


Figure 6.4- 1146\_2101 Post test picture



## Appendix 7 - Load graphs.

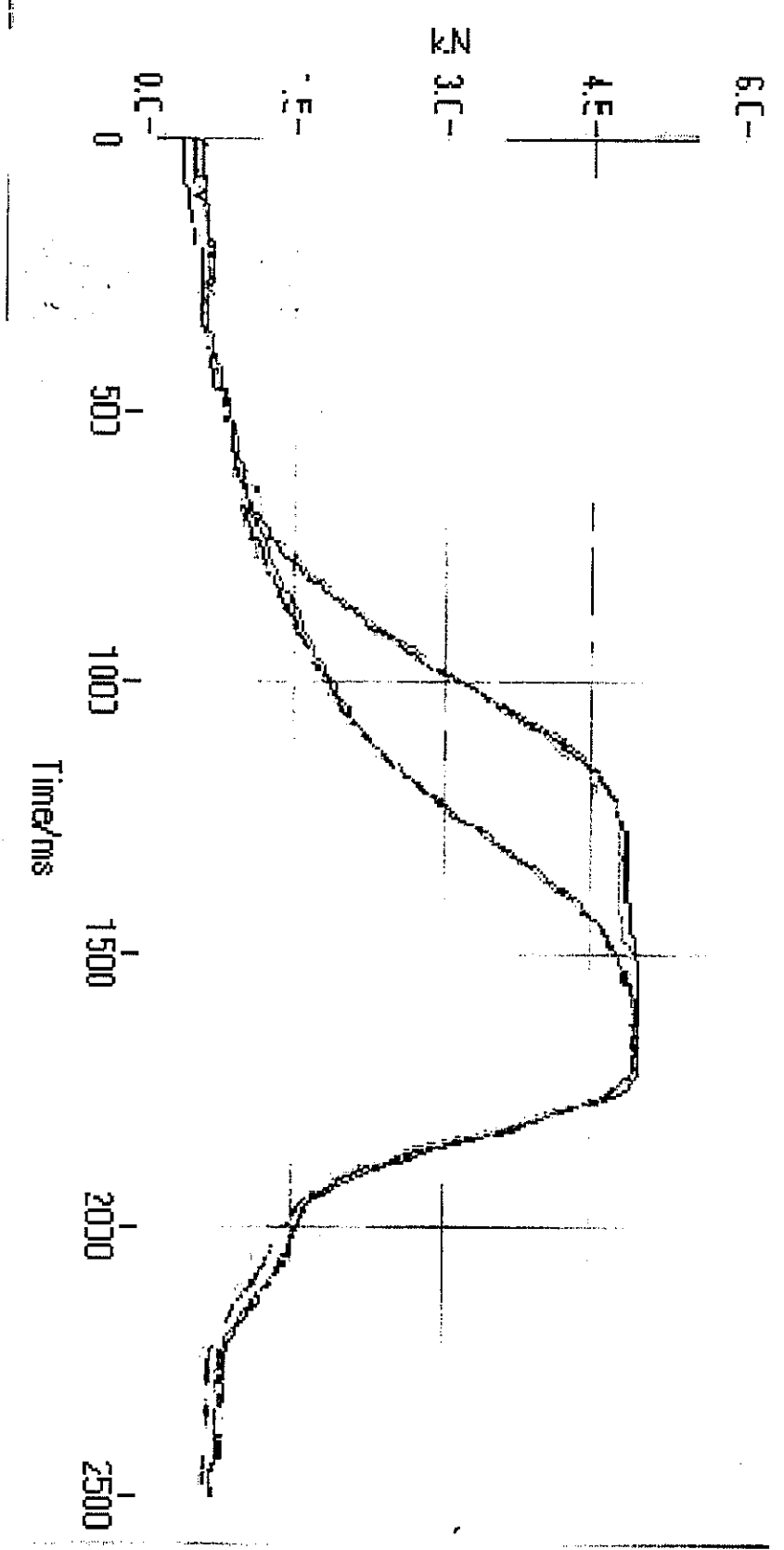
### Graph Channel Key

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

### Test Channel Allocation

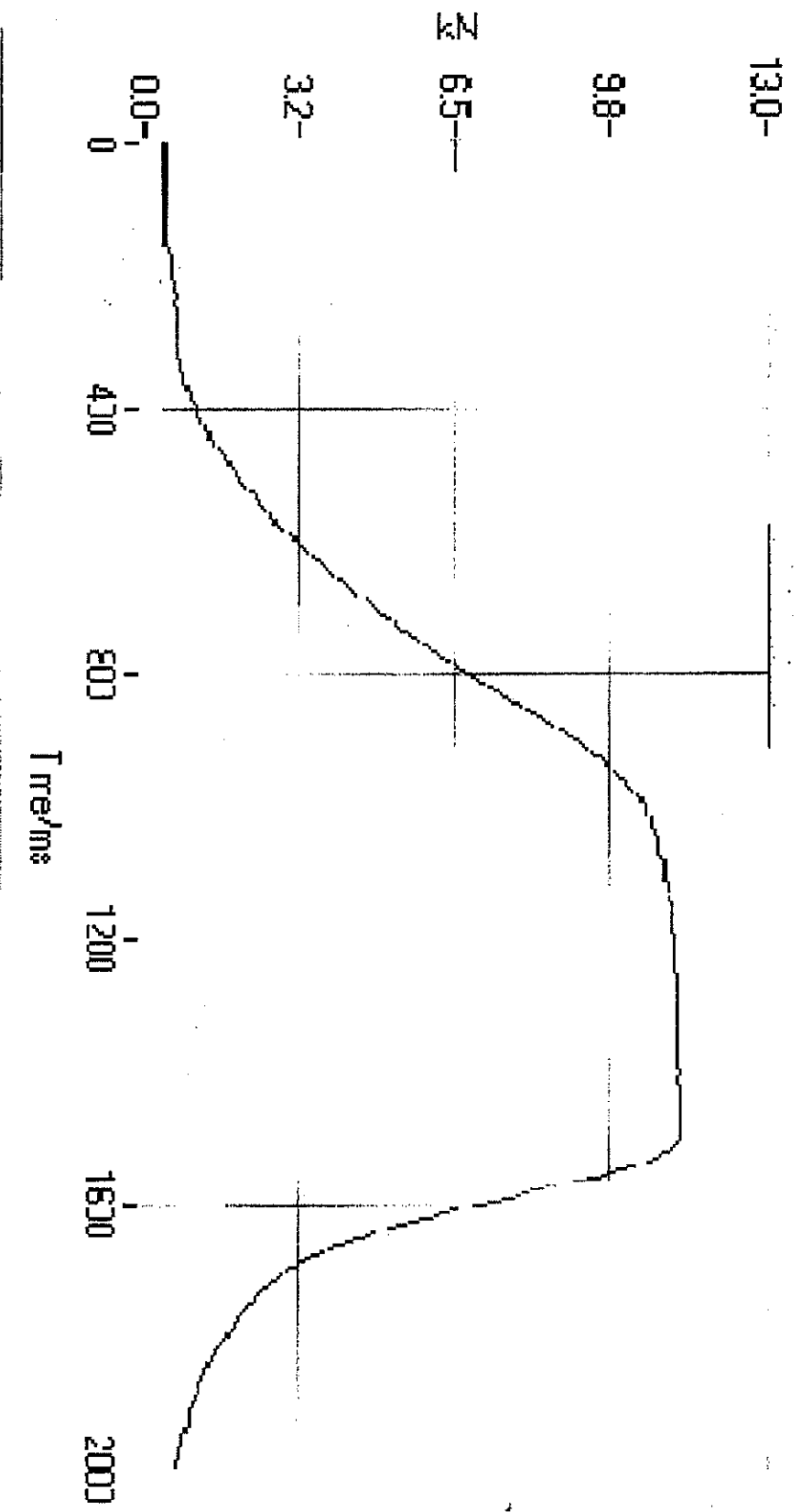
| Test Ref  | Load Position | Channel Number |        |     |
|-----------|---------------|----------------|--------|-----|
|           |               | Seat Position  |        |     |
|           |               | RHS            | Centre | LHS |
| 1146_2097 | Diag          | 8              | 6      | 4   |
|           | Lap           | 7              | 5      | 3   |
| 1146_2098 | W/chair       | 3              | N/A    | N/A |
| 1146_2099 | Diag          | 8              | 6      | 4   |
|           | Lap           | 7              | 5      | 3   |
| 1146_2101 | Diag          | N/A            | 3 & 7  | N/A |

|                           |   |
|---------------------------|---|
| Test Reference: 1146_2097 | Test Details: Test of First row of seats to M1 (M3 load for reverse facing seats) |
|---------------------------|---|

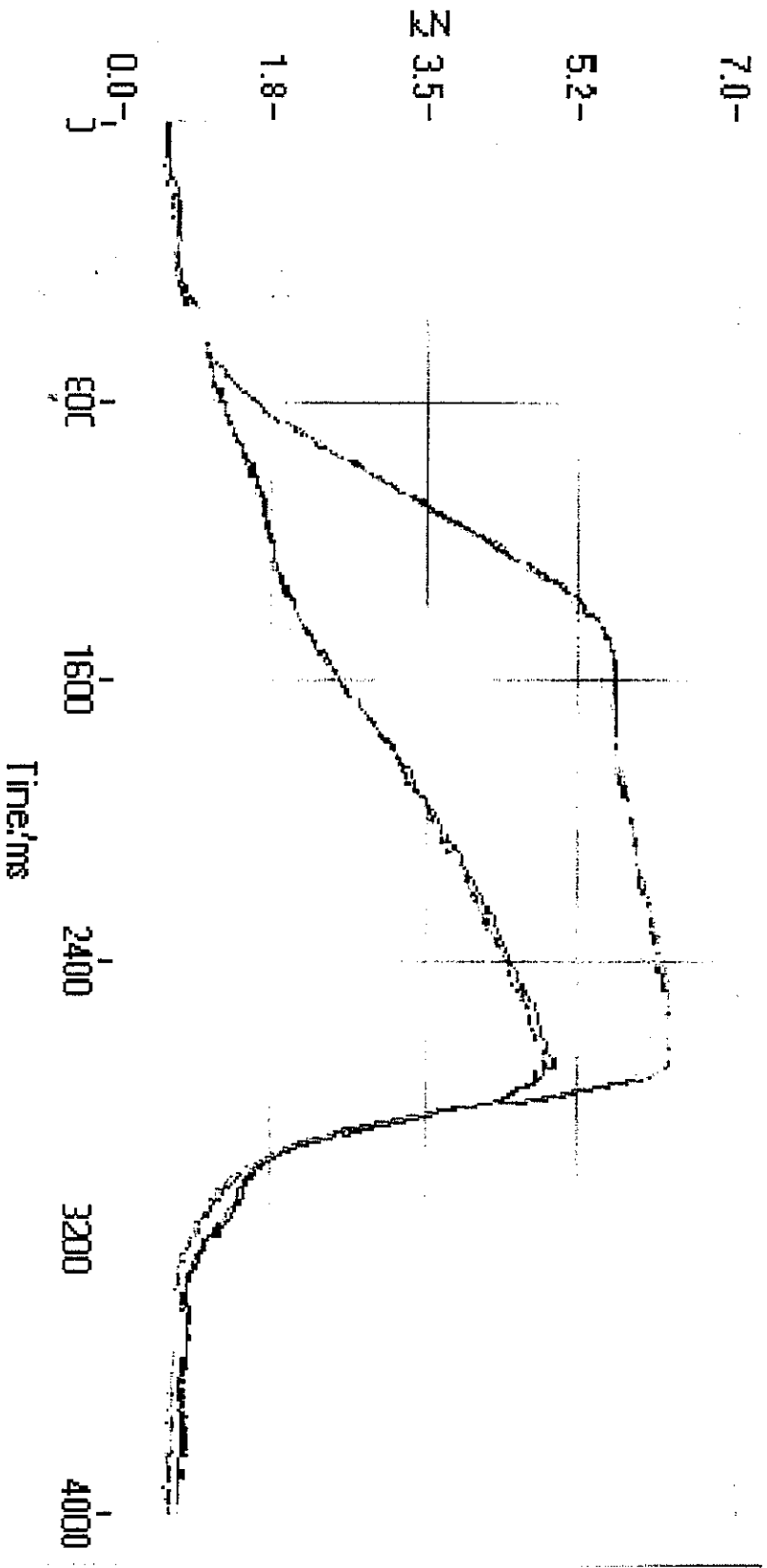


Test Reference: 1146\_2098

Test Details: Test of the reverse facing wheelchair rear restraint in the rearward direction.



|                           |  |
|---------------------------|--|
| Test Reference: 1146_2099 | Test Details: Test of the second row of seats to M1 (M3 load for reverse facing seats) |
|---------------------------|--|





Test Reference: 1146\_2101      Test Details: Simulation of the forward facing w/chair and occupant restraint

