MIRA

Project Report

A FRONTAL IMPACT TEST OF A MIDAS GOLD CAR,
FOR STEERING COLUMN DISPLACEMENT IN ACCORDANCE
WITH ECE 12 AND EEC 74/297

MIRA TEST NO C78; CARRIED OUT ON 11 MARCH 1986

MIRA PROJECT NO K435500

The Motor Industry Research Association

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Director: **Dr C Ashley CBE**

MIRA CONFIDENTIAL PROJECT NO. 435500

Carried out for: Midas Cars Limited

On the authority of: Letter dated 7 March 1986

Company Liaison Engineer Mr H J R Dermott

Report No: K435500

Title

A Frontal Impact Test of a Midas Gold Car, for Steering Column Displacement in Accordance with ECE 12 and EEC 74/297.

MIRA Test No C78, carried out on 11 March 1986.

MIRA Staff B F Smith

Supervision by: Dr D G C Bacon

Report Approved

C ASHLEY, PhD, C Eng
DIRECTOR

Date: 2.4.86

SUMMARY

A frontal impact test was carried out on a Midas Gold motor car to determine whether its steering column displacement met the requirements of ECE Regulation 12 and EEC Directive 74/297.

The vehicle was towed up to a speed of 49.2 km/h (30.6 mile/h) and then allowed to run into an immovable 90° barrier. The column displacement was measured by means of a combination of linear and rotary potentiometers, and high speed film was taken of the test.

The horizontal rearward displacement of the column reached a peak of 15 mm, which is well inside the limit of 127mm permitted by the two standards. The vehicle therefore meets the requirements of the standards in respect of its column displacement.

CONTENTS

A FRONTAL IMPACT TEST OF A MIDAS GOLD MOTOR CAR FOR STEERING COLUMN DISPLACEMENT IN ACCORDANCE WITH ECE 12 AND EEC 74/297

1. INTRODUCTION

On 11 March 1986 a Midas Gold motor car was subjected to a test for steering column displacement in a frontal impact. The test was carried out at the Crash Test Facility of the Motor Industry Research Association, in accordance with instructions received from Midas Cars Limited. The personnel present included:

Mr H J R Dermott	Midas Cars Limited
Mr J Southall	Somar Transtec Limited
Mr B F Smith	Motor Industry Research Association
Mr D Poritt	Department of Transport, UK

2. OBJECTIVE

The aim of the test was to determine whether a Midas Gold motor car would meet the steering column displacement requirements of two similar standards, ECE Regulation 12 and EEC Directive 74/297. These standards contain further requirements on the protection of the driver in the event of impact with the steering assembly, which are not within the scope of the present report.

3. SUMMARY OF REQUIREMENTS

The two standards specify that the vehicle to be tested shall be run into an immovable barrier, with a flat face at right angles to the direction of travel of the vehicle. The speed of the vehicle shall be at least 48.3 km/h (30 mile/h).

The standards then require that the horizontal displacement of the top of the steering column, relative to an undeformed part of the vehicle, shall not exceed 127mm (5 inches).

4. VEHICLE DETAILS

The test vehicle was a Midas Gold motor car in right hand drive form. The vehicle was a two door model and had an Austin Rover Metro engine and integral transmission fitted transversly and giving front wheel drive. It was a pre-production vehicle that was built specially for this test. Photographs of the vehicle before the test can be seen in Plates 1, 3 and 7.

5. TEST EQUIPMENT

5.1 Propulsion System and Barrier

The MIRA Crash Test Facility is provided with a vehicle propulsion system which consists of a Linear Induction Motor running on an underfloor track. When mains power is provided, the motor accelerates to a terminal speed which then remains constant within very close limits. The vehicle is towed behind the motor, and is released some 3m before impact.

The barrier is constructed of concrete and weighs some 110 tonnes. Its front face is flat, 1.830m by 3.66m, and at right angles to the direction of travel of the vehicle. The front face is covered by a sheet of 20mm plywood, as required by the Directives.

5.2 Dummies

An anthropomorphic dummy representing the dimensions of the 50th percentile male, was used in this test. The dummy was of a construction which conformed to the requirements of Part 572 of the Federal Register. The dummy was installed in the vehicle following the procedure set down in FMVSS 208. The dummy was used to assess the performance of the restraint system. The results of its performance are not discussed in this report.

5.3 Instrumentation

The speed of the vehicle was measured by a cardboard fin, which was mounted to the underside of the vehicle, cutting through two light beams some 670mm apart. The interuption of each light beam was detected by an associated photocell and an electronic timer measured the time between the two. The speed was calculated from the time and the known distance.

Steering column displacement was measured by a linear and rotary potentiometer combination specially designed for this purpose. The linear potentiometer is connected to the centre of the steering column, the other end of the linear potentiometer being connected to a platform installed on an undeformed part of the vehicle. Two rotary potentiometers measure the angles between the linear potentiometer and the fixed platform. The combination measures the location of the steering column centre in a set of polar co-ordinates based on the platform.

Four accelerometers of the unbonded strain gauge type, were used to record the longitudinal deceleration of the vehicle. They were located adjacent to the base of the B-post, on each side of the vehicle and to the front and rear of the left hand side sill. These accelerometers had a range of $\pm$ 250 g.

The calibration status and accuracy of the transducers is given in Table 1.

The outputs from the transducers were fed to a rack of FM tape recorders, and in parallel they were recorded by a rack of UV galvanometer recorders. A crystal controlled oscillator was used to provide timing and synchronising signals for all of the recorders as well as for the cameras. This gives all the records and films a common timing system.

The instrumentation system conforms with the requirements of SAE J211a.

5.4 Photography

The test was filmed by a total of six high speed cameras loaded with colour film. Details are given in Table 2.

Photographic lighting, of a colour temperature of 3200°K, is provided in the facility. Timer discs, rotating at a speed of 1 revolution every 20ms, are included within the view of many of the cameras. These are driven by synchronous motors from the mains supply. The cameras were also provided with internal light sources (LED) which marked the edge of the film with pulses at 4ms intervals, synchronised with those used on the electronic recorders. A longer pulse identified the time of the first contact of the vehicle with the barrier.

6. TEST METHOD

6.1 Vehicle Preparation

The vehicle was painted, on its exterior and underneath surfaces, with matt emulsion paint. To help distinguish the different systems, they were colour coded as follows:

Blue	Main external surface of vehicle
Orange	Chassis
Pink	Suspension
Green	Steering system

Distance markers at 250mm spacings were fixed along the waist line.

The vehicle was drained of all fluids and the fuel tank re-filled with 32.5 litres of fuel substitute. The driver's seat was removed and the platform installed for the measurement of steering column movement. An anthropomorphic dummy with a mass of 75 kg was seated in the passenger side seat.

The vehicle was then ballasted with two lead blocks in the front floor area, and one in the rear luggage compartment, each with a mass of 26 kg. In addition a 12.5 kg bag of lead shot was put into the front footwells, with another in the passenger side glove box.

On completion of these preparations the vehicle was weighed. The total mass was found to be 832 kg of which 511 kg was on the front wheels and 321 kg on the rear.

6.2 Impact Test

The vehicle was positioned astride the track, its brakes disengaged and gearbox in neutral, pointing towards the barrier. The linear induction motor was coupled to the vehicle by two short towing cables.

The timer controlling the operation of the test was activated. This automatically recorded a gauging signal on each of the instrumentation channels, then switched on the high speed cameras and their lights and finally operated the propulsion system. The impact then occurred.

7. RESULTS

7.1 Test Records

Complete records of the test are extensive and have therefore been supplied as a separate pack. This includes photographs taken before and after impact, high speed films, UV galvanometer records, digital listings of computed results and computer generated graphs.

This report aims to present the more significant results obtained from the full records.

7.2 Speed of Vehicle

The speed of the vehicle just before impact was 49.2 km/h (30.6 mile/h). This exceeds very slightly the 48.3 km/h (30.0 mile/h) minimum requirement of the standards.

7.3 Photography

Plates 1 and 2 show the left side of the vehicle before and after the test. Similar views of the right side are shown in Plates 3 and 4. The steering assembly is shown before and after the test in Plates 5 and 6. Views of the front of the vehicle may be seen in Plates 7 and 8.

7.4 Measurements of Vehicle Crush

The crush of the vehicle, as measured by the reduction in length after the impact was 390 mm on the left side and 380 mm on the right side. The wheelbase had shortened by 80 mm on the left side and by 78 mm on the right side. The reduction in wheelbase was due almost entirely to the rearward displacement of the front wheels. The vehicle rebounded 800 mm from the face of the barrier.

7.5 Deceleration of the Vehicle

The deceleration of the main body structure of the vehicle may be seen in Figure 1. After reaching a peak of 69 g at 16 ms, the deceleration diminished to zero at 75 ms. Other deceleration histories can be seen in Figures 2, 3 and 4.

7.6 Displacement of the Steering Column

An inspection of the vehicle showed that the part of the vehicle on which the potentiometer platform was mounted had not been deformed by the impact.

Figure 5 shows a computer generated graph of the rearward displacement of the steering column. This was calculated from the readings of the linear potentiometer and the two rotary potentiometers.

The result shows a maximum rearward displacement of 15 mm, occurring at 39 ms. After the peak the dynamic displacement reduces, due to recovery of the structure. When measured manually after the test, the static displacement of the column was found to be 5 mm confirming the result obtained from the instrumentation.

The peak horizontal displacement of the steering column was therefore less than the maximum of 127mm permitted by the two standards.

Figure 6 shows the vertical movement of the steering column, plotted against the horizontal movement as to give a locus in space. This is not required for legislation purposes.

8. CONCLUSION

The vehicle as tested met the requirements of ECE Regulation 12 and EEC Directive 74/297 in respect of the rearward horizontal displacement of its steering column.

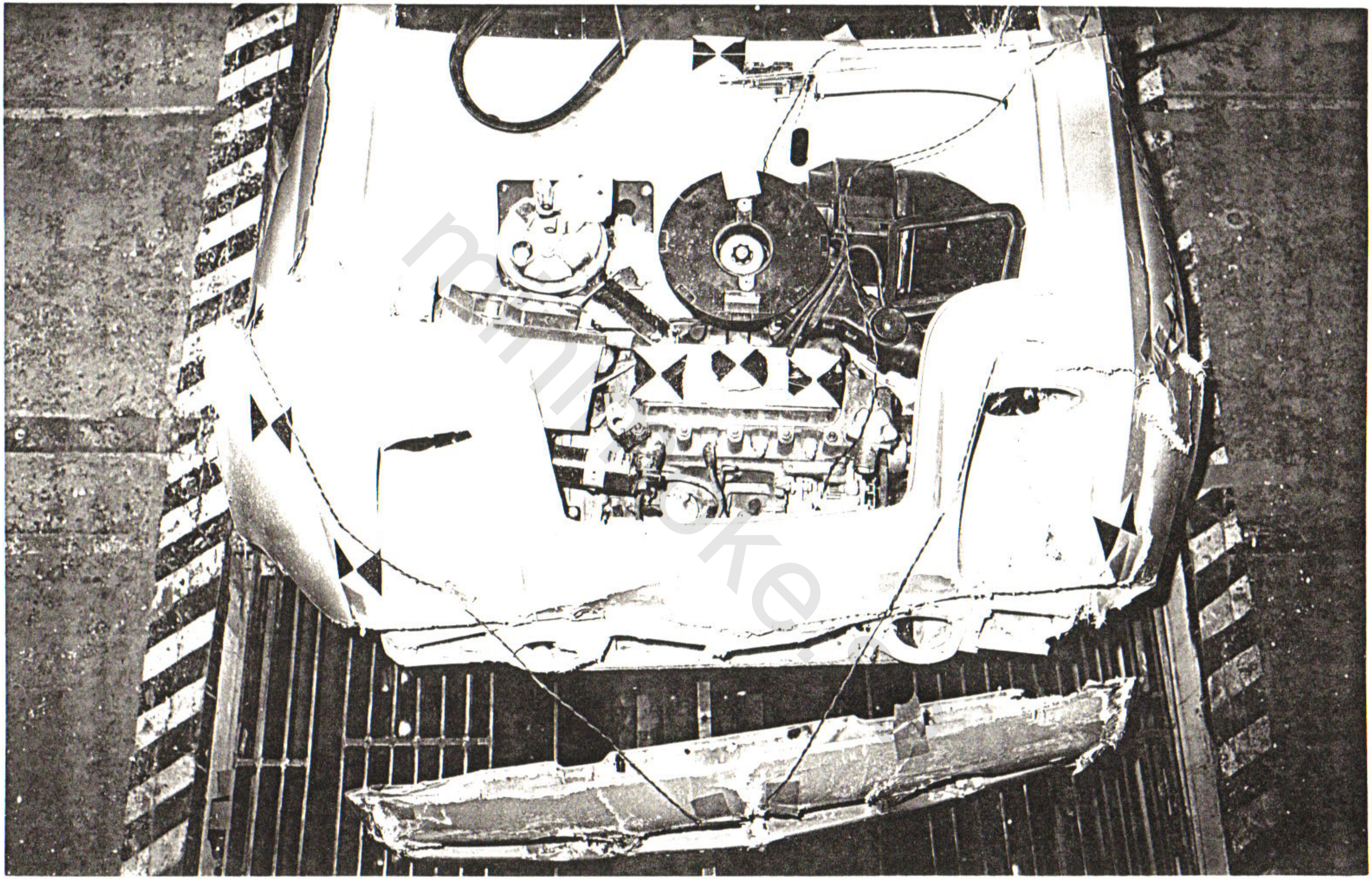


Plate 8 Front of the vehicle after the test

MIRA

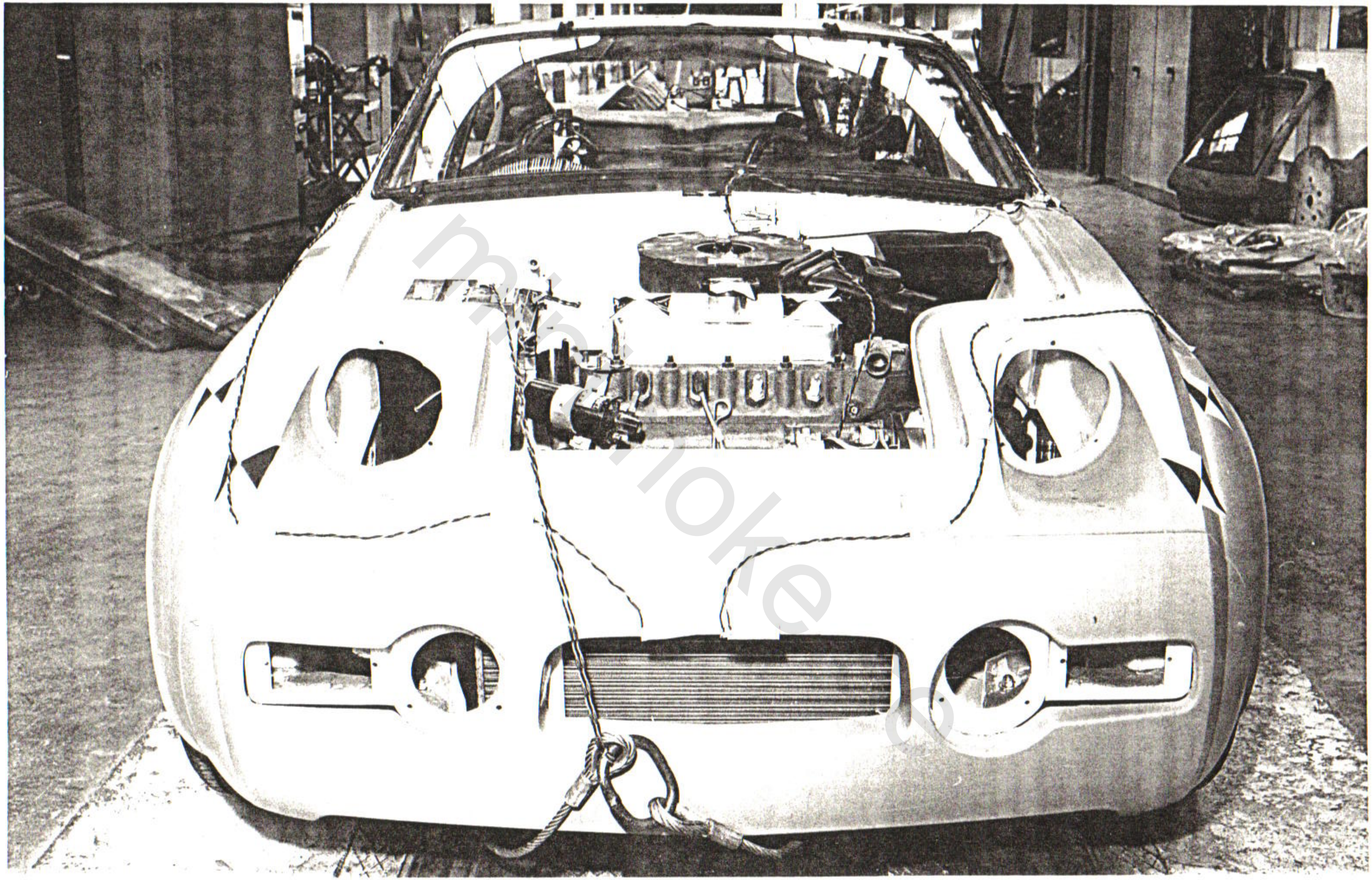


Plate 7 Front of the vehicle before the test

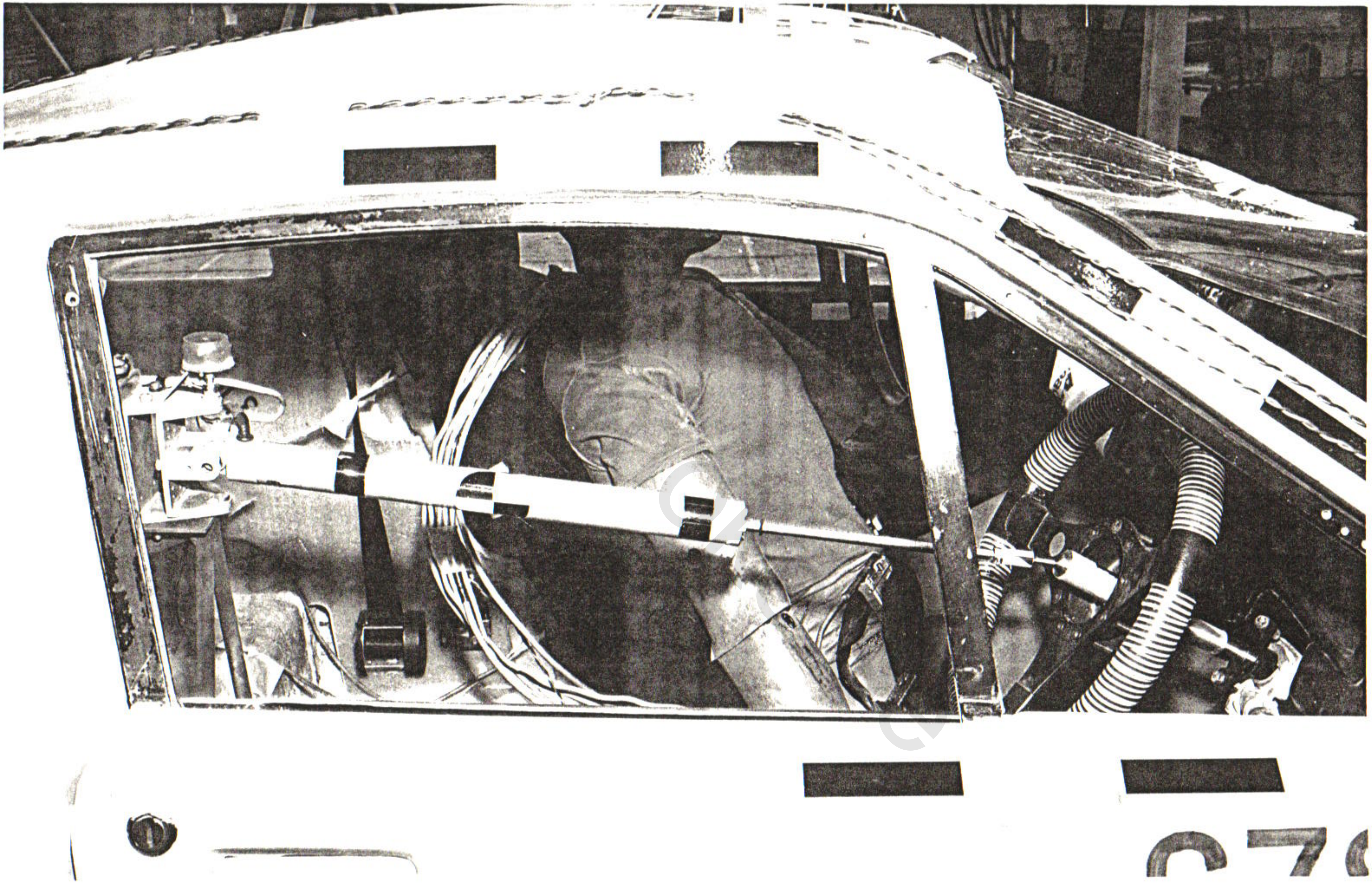


Plate 6 Steering column displacement transducer after the test

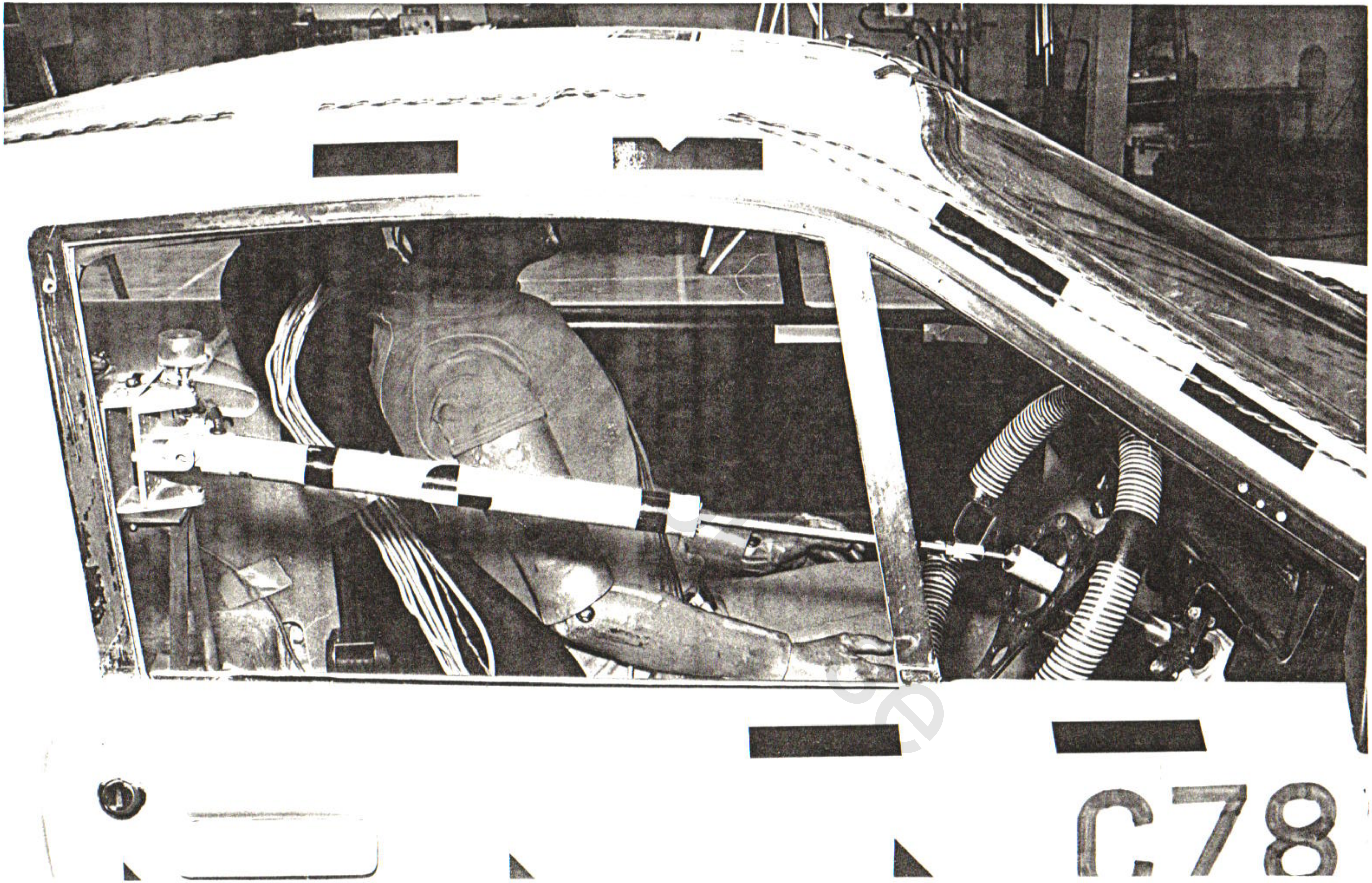


Plate 5 Steering column displacement transducer before the test

Plate 4 Right side of the vehicle after the test

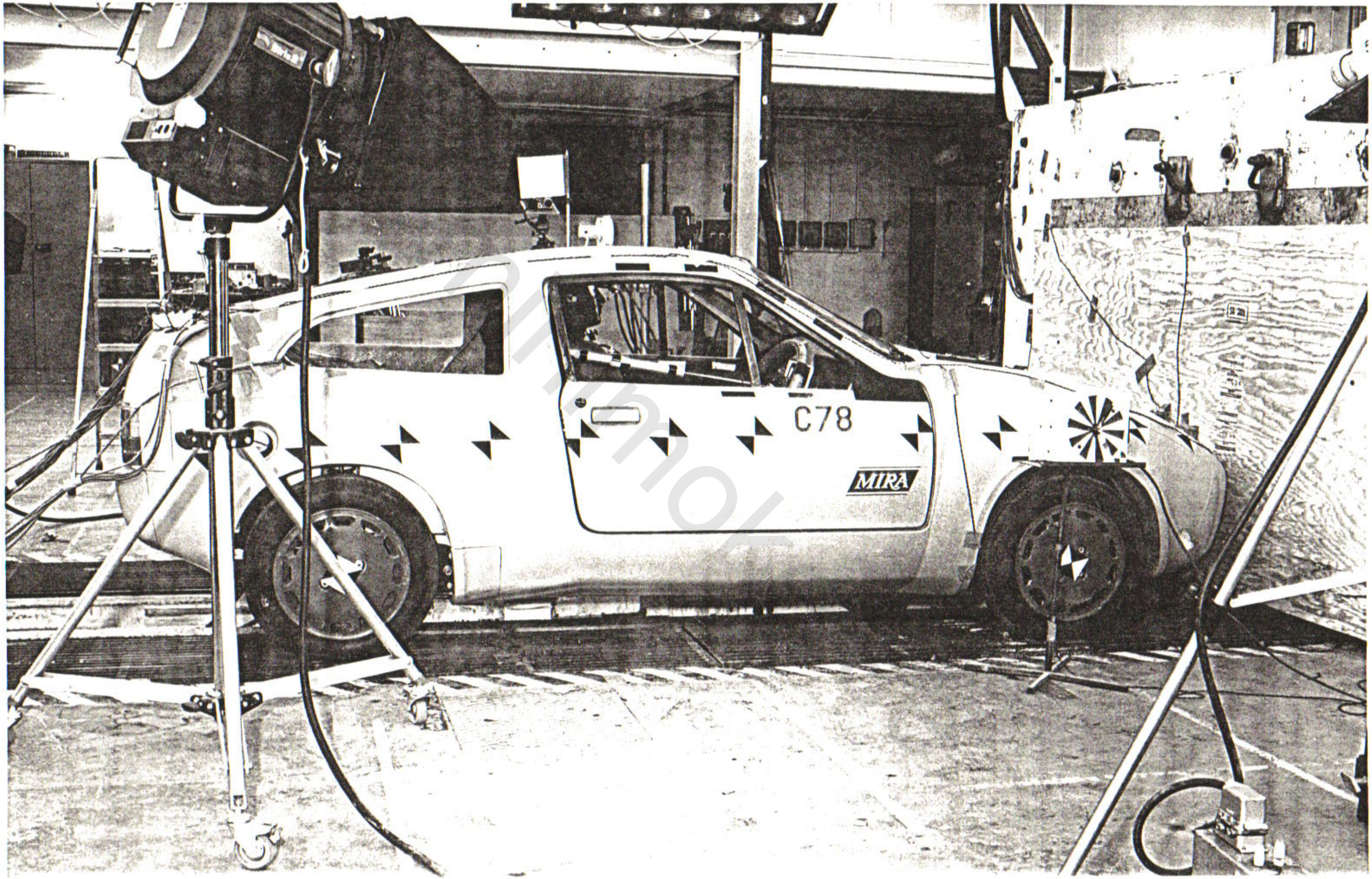


Plate 3 Right side of the vehicle before the test

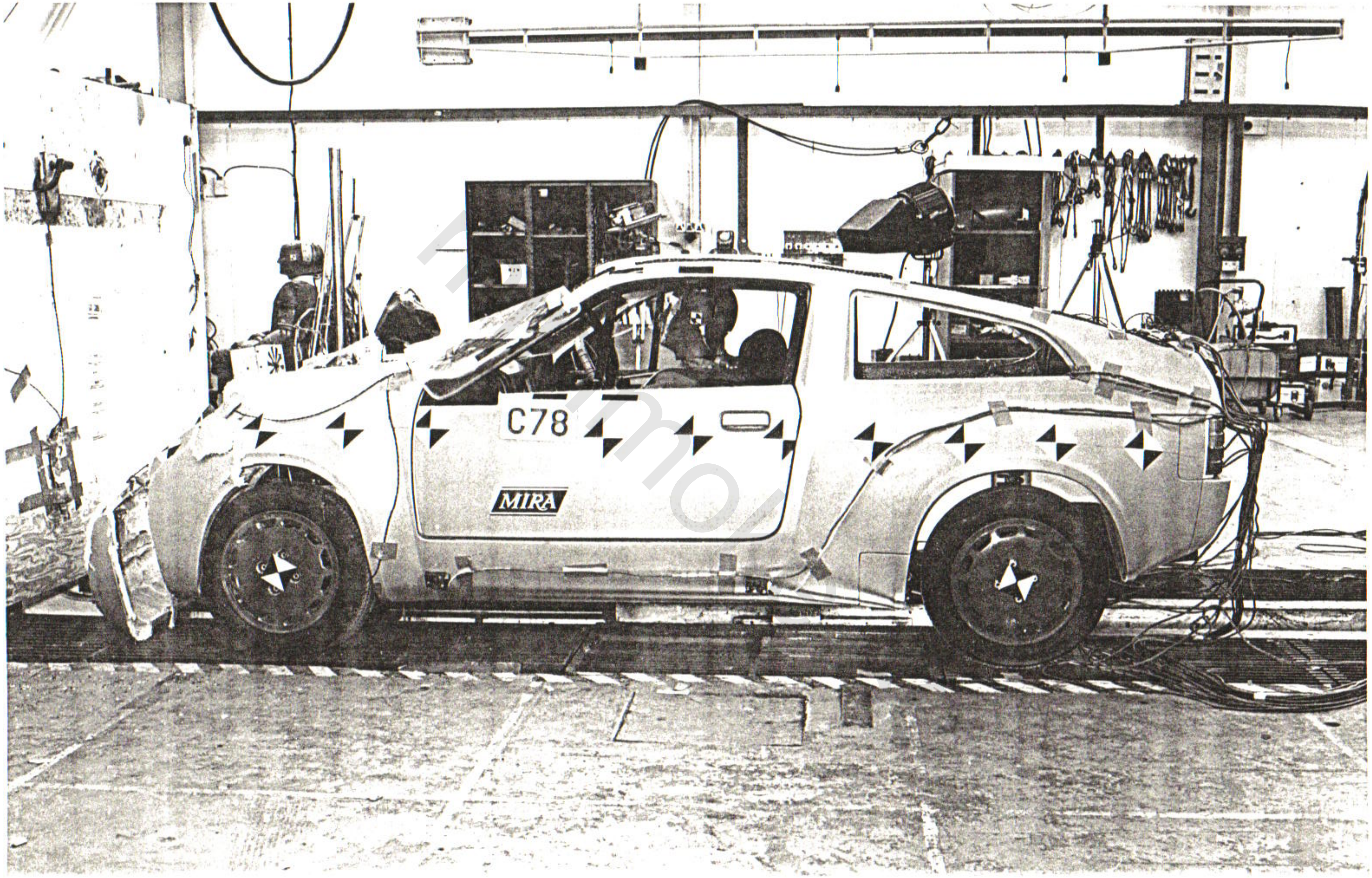


Plate 2 Left side of the vehicle after the test

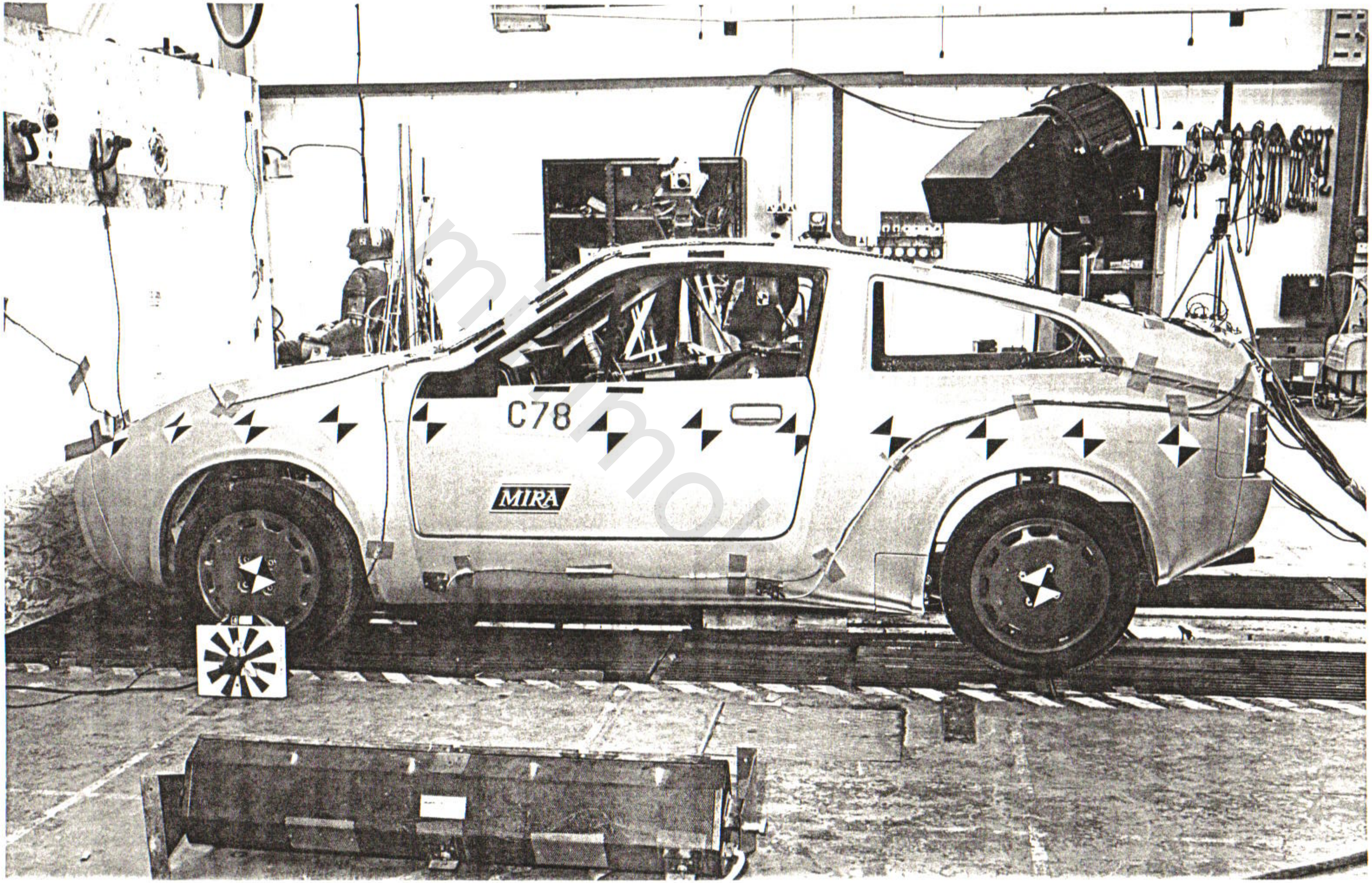


Plate 1 Left side of the vehicle before the test

LIST OF PLATES

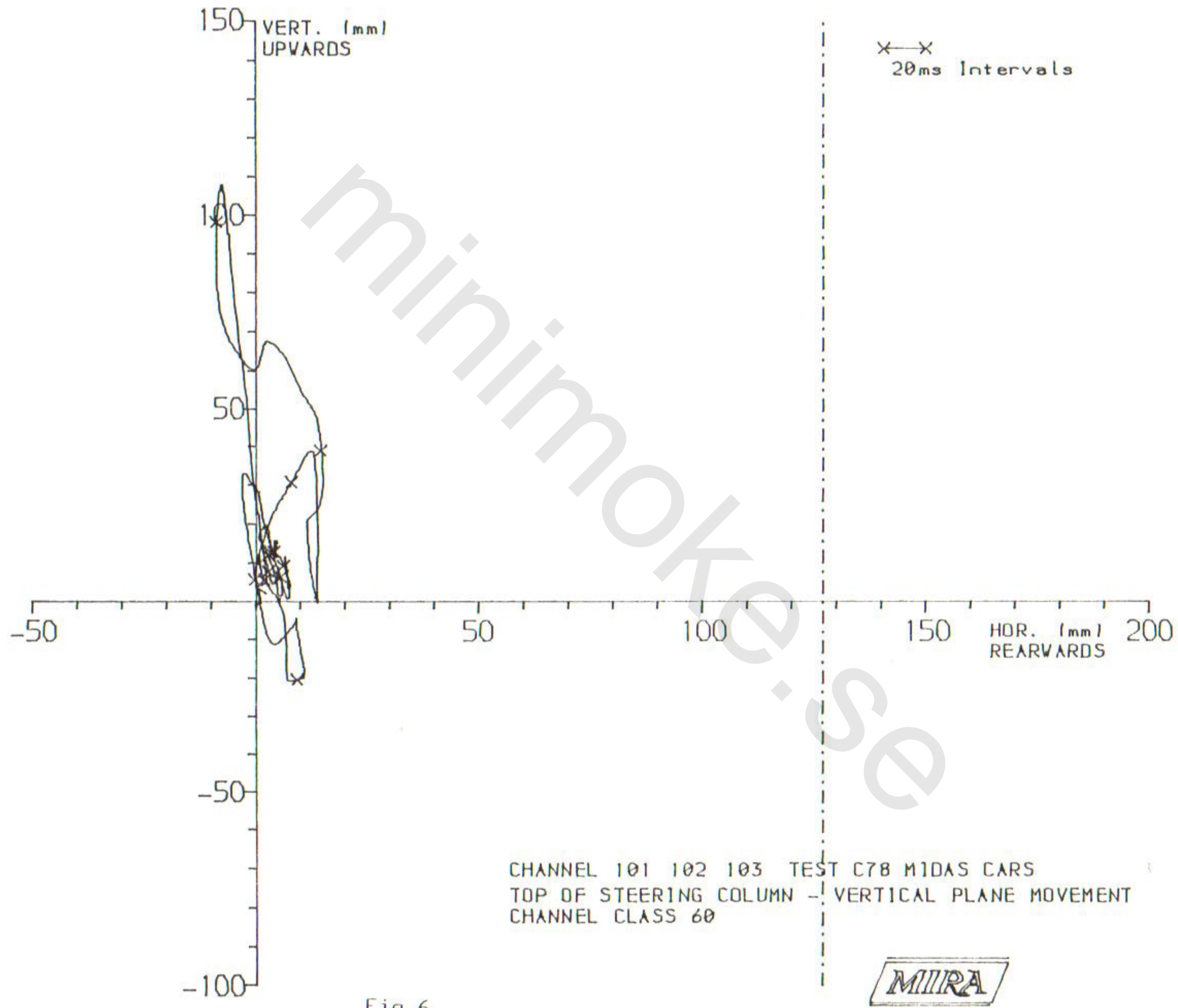
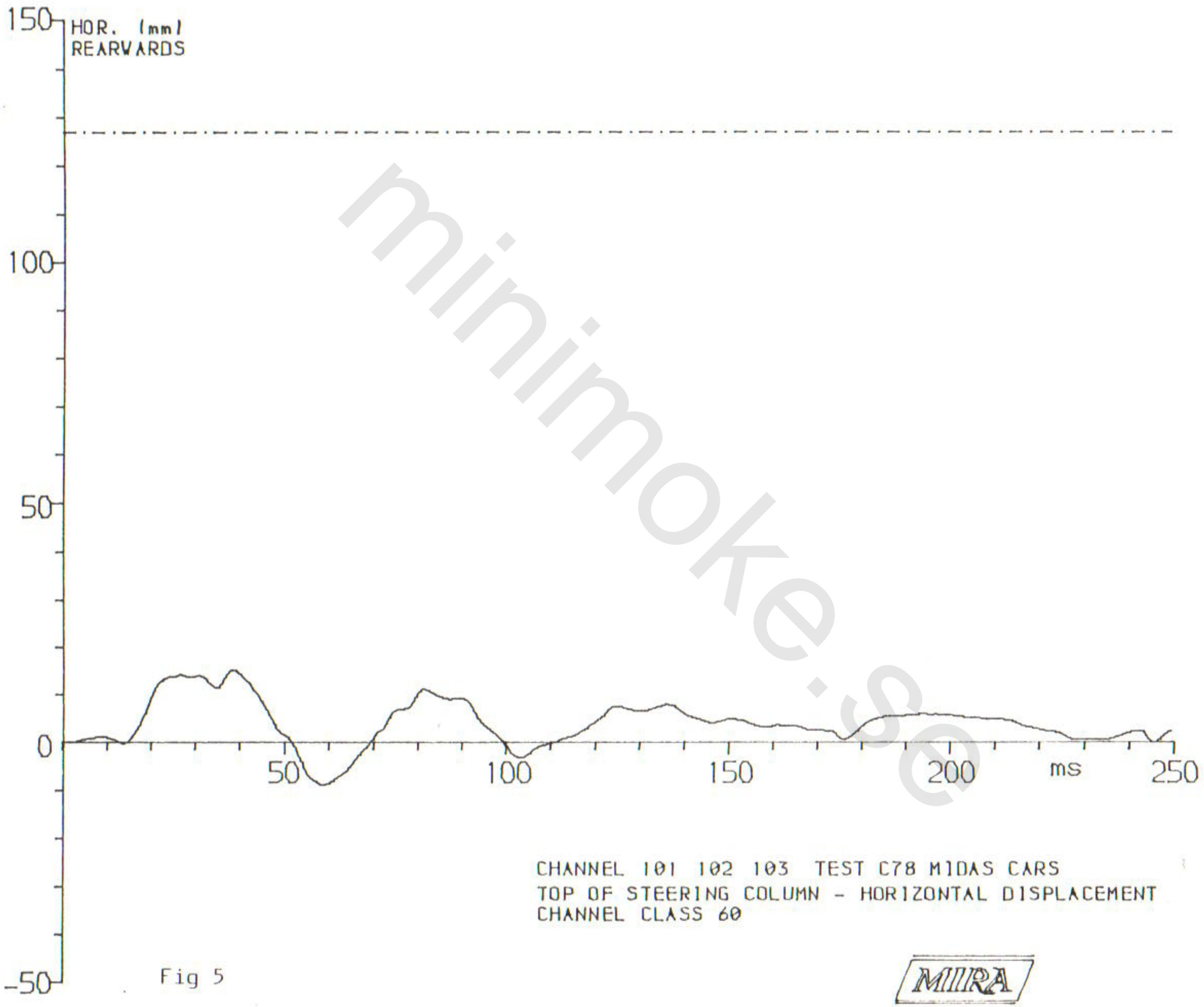

150
VERT. (mm)
UPWARDS
100
50
-50
-100
20ms Intervals
-50
50
100
150
200
HOR. (mm)
REARWARDS
CHANNEL 101 102 103 TEST C78 MIDAS CARS
TOP OF STEERING COLUMN - VERTICAL PLANE MOVEMENT
CHANNEL CLASS 60
MIRA

Fig 6



150
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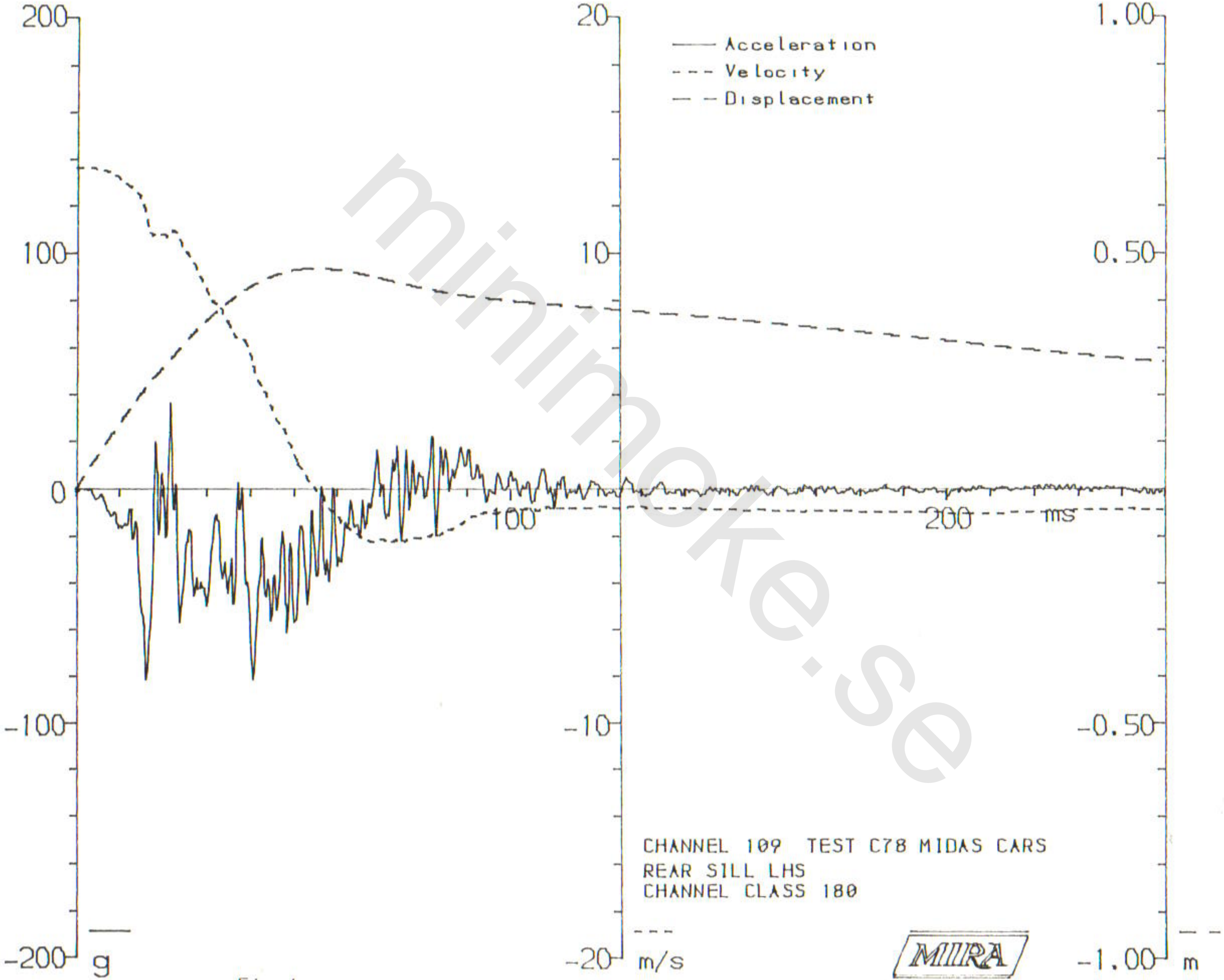
-50
HOR. (mm)
REARWARDS
50
100
150
200
ms
250
CHANNEL 101 102 103 TEST C78 MIDAS CARS
TOP OF STEERING COLUMN - HORIZONTAL DISPLACEMENT
CHANNEL CLASS 60

Fig 5

MIRA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Acceleration
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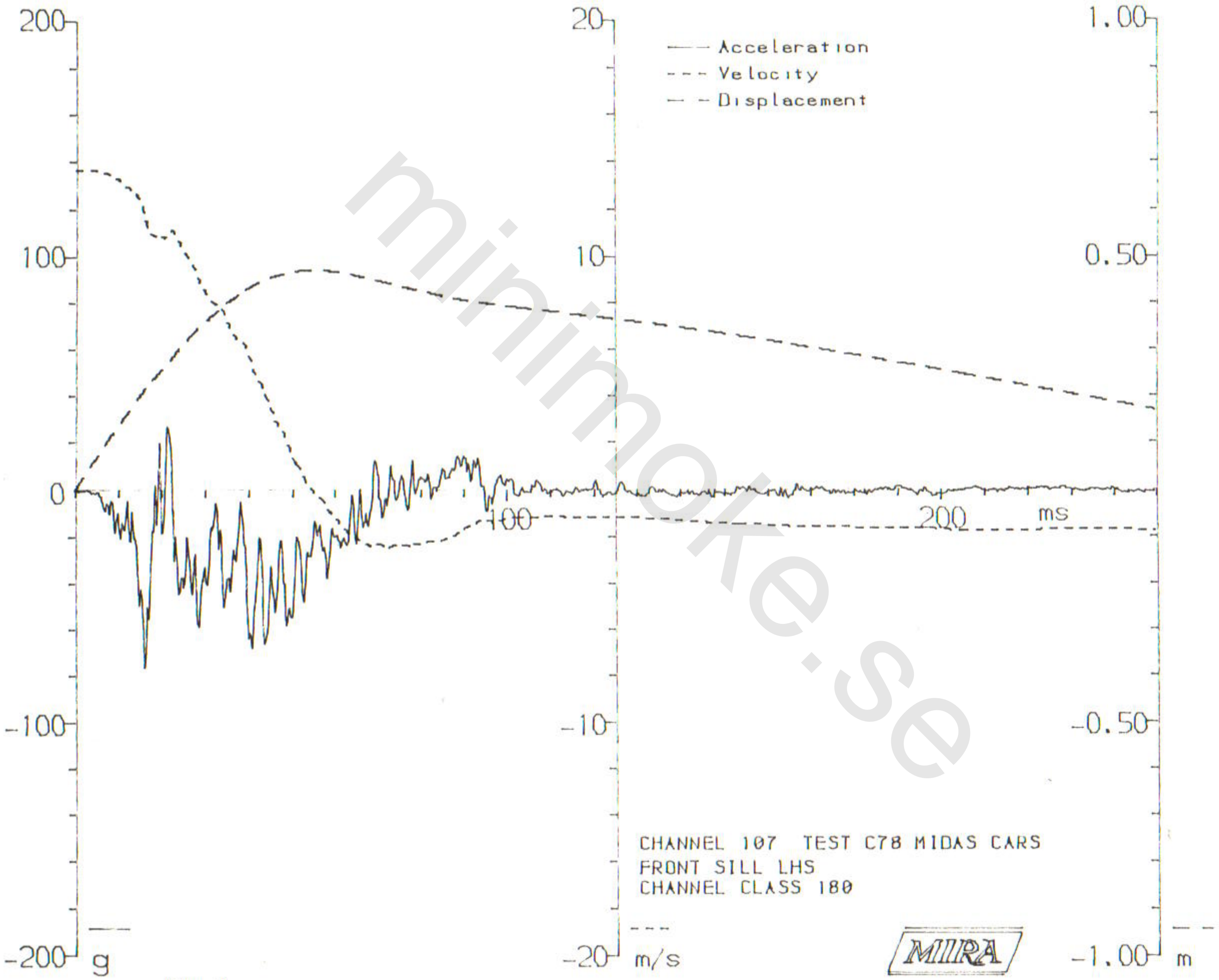
ms
CHANNEL 109 TEST C78 MIDAS CARS
REAR SILL LHS
CHANNEL CLASS 180
MIRA
minimoke.se

Fig 4



Acceleration
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ms
CHANNEL 107 TEST C78 MIDAS CARS
FRONT SILL LHS
CHANNEL CLASS 180
MIRA
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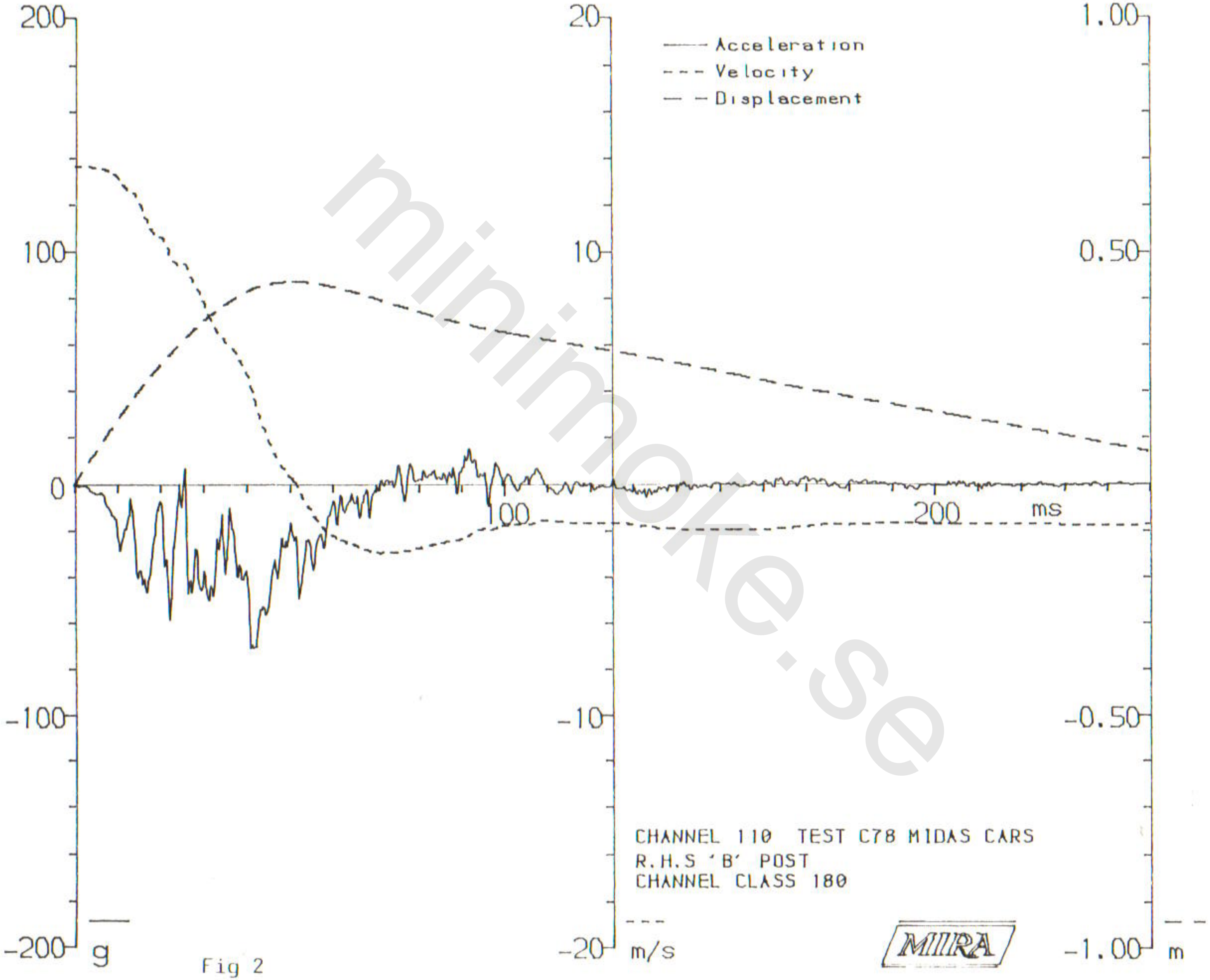
Fig 3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m
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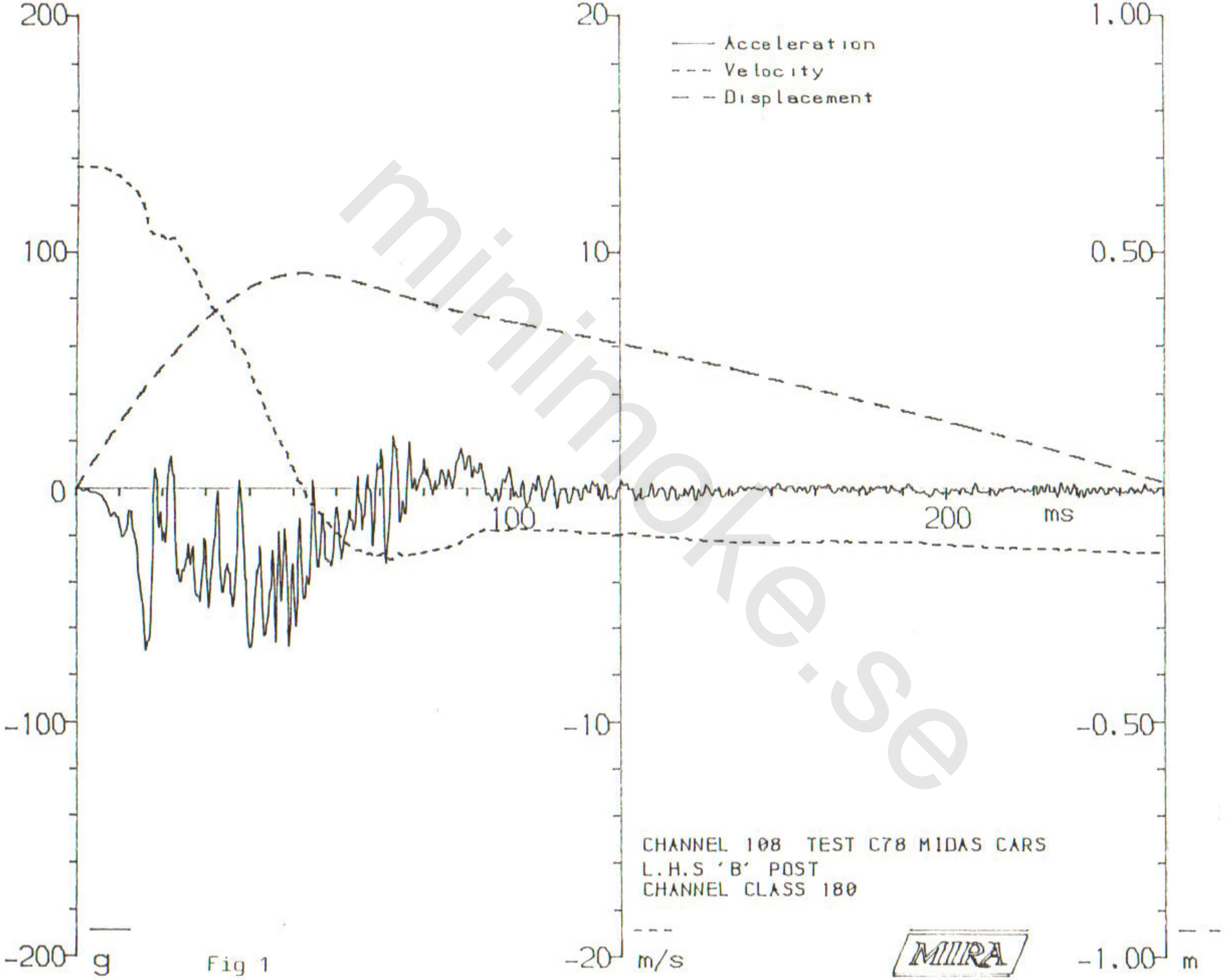
200
ms
Acceleration
Velocity
Displacement
CHANNEL 110 TEST C78 MIDAS CARS
R.H.S 'B' POST
CHANNEL CLASS 180
MIRA

Fig 2



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m/s
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-1.00
m
Acceleration
Velocity
Displacement
100
200
ms
CHANNEL 108 TEST C78 MIDAS CARS
L.H.S 'B' POST
CHANNEL CLASS 180
MIRA

Fig 1

LIST OF FIGURES

TABLE 2 - DETAILS OF HIGH SPEED CAMERAS USED ON TEST

Camera No	Body		Lens	Nominal Speed*	View	Location			Comment
	Type	Ref No	Focal Length			X m	Y m	Z m	
1	Photosonic	PS 3	13 mm	1000 pps	LH General	1.50	-5.30	1.47	
2	NAC	E 194	25 mm	1000 pps	LH front half of car	0.90	-7.50	1.05	
3	Photosonic	PS 5	17 mm	1000 pps	RH of steering wheel	1.60	3.00	1.45	
4	Photosonic	PS 7	13 mm	1000 pps	Overhead	0.50	0	5.60	
5	NAC	E 149	25 mm	1000 pps	LH front close-up	0.20	-3.60	0.60	
6	Photosonic	PS 2	13 mm	1000 pps	Underside	0.50	0.40	-1.69	

* The exact speed can be determined form the 250 Hz LED flashes on the side of each film

X = Longitudinal distance from face of concrete block (positive in direction of vehicle)

Y = Lateral distance from centreline of vehicle (positive towards vehicle RHS)

Z = Height above ground (positive upwards)

TABLE 1 - ACCURACY AND CALIBRATION STATUS OF TRANSDUCERS

Type	Range	MIRA Ref Nos	Accuracy	Calibration Schedule	Calibration Status
Speed Measurement			± 0.5%	Immediately before the test	OK
Base of LH B-post	± 250 g	QA 309	± 5 %	6 monthly intervals	OK
Base of RH B-post	± 250 g	QA 390	± 5 %	6 monthly intervals	OK
Front of LH sill	± 250 g	QA 292	± 5 %	6 monthly intervals	OK
Rear of LH Sill	± 250 g	QA 412	± 5 %	6 monthly intervals	OK
Steering Potentiometer	300 mm	QA 802	± 5 %	6 monthly intervals	OK