HS 6372960

REPORT NUMBER: 201-VER-04-01

SAFETY COMPLIANCE TESTING FOR FMVSS 201 OCCUPANT PROTECTION IN INTERIOR IMPACT

GENERAL MOTORS OF CANADA LTD.
2004 PONTIAC GRAND PRIX 4-DOOR SEDAN

NHTSA NUMBER: C40101

GD TEST NUMBER: 8655-F201-24

ADVANCED INFORMATION ENGINEERING SERVICES
A GENERAL DYNAMICS COMPANY
TRANSPORTATION SCIENCES CENTER
P.O. BOX 400
BUFFALO, NEW YORK 14225

Test Date: July 13, 2004

FINAL REPORT

PREPARED FOR:

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
Mail Code: NVS-220, Room 6111
400 Seventh Street, SW
Washington, DC 20590

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Prepared by:

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Approved by:

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Transportation Science Center

Approval Date: August 5, 2004

FINAL REPORT ACCEPTANCE BY:

NHTSA, Office of Vehicle Safety Compliance

8.16.2004

Date of Report Acceptance

received yet
10-7-04 JS

TECHNICAL REPORT STANDARD TITLE PAGE

1. *Report No.* VER-04-01	2. *Government Accession No.*	3. *Recipient's Catalog No.*
4. *Title and Subtitle* Final Report of FMVSS 201 Compliance Testing of a 2004 Pontiac Grand Prix 4-door Sedan NHTSA No. C40101		5. *Report Date* July 13, 2004 6. *Performing Organization Code* VER
7. *Author(s)* David J. Travale, Program Manager James Czarnecki, Project Engineer		8. *Performing Organization Report No.* 8655-F201-24
9. *Performing Organization Name and Address* Advanced Information Engineering Services A General Dynamics Company 4455 Genesee Street Buffalo, New York 14225		10. *Work Unit No.* 11. *Contract or Grant No.* DTNH22-01-C-01025
12. *Sponsoring Agency Name and Address* U.S. Department of Transportation National Highway Traffic Safety Administration Office of Vehicle Safety Compliance Mail Code: NVS-220 400 Seventh, SW, Room 6111 Washington, D.C. 20590		13. *Type of Report and Period Covered* Final Report July 2004 14. *Sponsoring Agency Code* NVS-220
15. *Supplementary Notes*		
16. *Abstract* Compliance tests were conducted on the subject vehicle, a 2004 Pontiac Grand Prix, 4-door Sedan, in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure TP-201-02 for determination of FMVSS 201 compliance. Test failures identified were as follows: None		
17. *Key Words* Compliance Testing Safety Engineering FMVSS 201	18. *Distribution Statement* Copies of this report are available from: NHTSA Technical Reference Division National Highway Traffic Safety Admin. 400 Seventh St., SW Washington, DC 20590	
19. *Security Classif. (of this report)* UNCLASSIFIED	20. *Security Classif. (of this page)* UNCLASSIFIED	21. *No. of Pages* / 22. *Price*

Form DOT F1700.7 (8-69)

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LIST OF DATA SHEETS

SECTION 1

PURPOSE AND TEST PROCEDURE

This head impact compliance test is part of the FMVSS 201 Occupant Protection in Interior Impact Test Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under Contract No. DTNH22-01-C-01025. The purpose of this impact compliance test was to determine whether the subject vehicle, a 2004 Pontiac Grand Prix 4-door Sedan, NHTSA No. C40101, meets the performance requirements of FMVSS 201, Occupant Protection in Interior Impact. The compliance test was conducted using the requirements found in the OVSC Laboratory Test Procedure No. TP-201-02 dated March 3, 1989.

SECTION 2

SUMMARY OF OCCUPANT PROTECTION IN INTERIOR IMPACTS

A, 2004 Pontiac Grand Prix, 4-door Sedan, NHTSA No. C40101, was impacted at various locations throughout its instrument cluster/dash panel and seat back area by a 15 lb, 6.5 inch diameter steel headform. A total of four (4) impacts were performed in this test series. The four (4) chosen impact points were:

Seat Back / Head Restraint Area

Instrument Panel Cluster Area

Airbag Cover / Dash Panel Area (2 impacts)

The selected impact areas on the test vehicle appeared to comply with the performance requirements of FMVSS 201.

The 6.5 inch diameter steel headform weighed 15 lb and had an accelerometer mounted along its centerline.

One (1) channel of data for each target impact test was recorded on a Keyser-Threde data acquisition system. Data plots can be found in Appendix C. Still photographs can be found in Appendix A of this report.

TEST VEHICLE RECEIVING INSPECTION DATA SHEET

VEHICLE YEAR/MAKE/MODEL/STYLE:	2004 Pontiac Grand Prix 4-door Sedan
NHTSA NO.:	C40101
VIN:	2G2WS542X41171754
DATE OF MANUFACTURE:	08/03 (SEE CERTIFICATION LABEL)
COLOR:	White
ODOMETER READING:	37 miles
LABORATORY:	GD Engineering
TEST DATE:	July 13, 2004

NUMBER OF SEATING POSITIONS:

FRONT: 2 REAR: 3

INSTRUMENT PANEL:

NOTE UNUSUAL FEATURES: None

TYPE OF FRONT SEATS:

BENCH: - BUCKET: X SPLIT BACKS: -

TYPE OF HEAD RESTRAINTS:

FIXED: - ADJUSTABLE: X

VEHICLE EQUIPPED WITH ARMRESTS?

NO: - YES: X NUMBER: 3

LOCATION: Front and rear door panels and center console arm rest

VEHICLE EQUIPPED WITH SUN VISORS?

NO: - YES: X

VEHICLE EQUIPPED WITH INTERIOR DOOR LATCHES?

NO: - YES: X NUMBER: 2

LOCATION: Glove Box and Center Console Arm Rest

HEADFORM IMPACT TEST RESULTS
INSTRUMENT PANEL

VEHICLE YEAR/MAKE/MODEL/STYLE:	2004 Pontiac Grand Prix 4-door Sedan
NHTSA NO.:	C40101
VIN:	2G2WS542X41171754
DATE OF MANUFACTURE:	08/03 (SEE CERTIFICATION LABEL)
COLOR:	White
ODOMETER READING:	37 miles
LABORATORY:	GD Engineering
TEST DATE:	July 13, 2004

IMPACT LOCATION AND NUMBER					VELOCITY (mph)	PEAK ACCELERATION (3 ms Clip) Gs
NUMBER		X (inches)	Y (inches)	ANGLE (degrees)		
1	Dash Cluster	21.9	-3.0	-10	11.5	57.06
2	Left Side of Airbag Cover	24.75	10.25	-45	11.4	59.00
3	Right Side of Airbag Cover	24.75	18.1	-45	11.5	70.10

REFERENCE POINT: Seating Reference Position (SGRP) on front passenger side is the reference point (x positive forward from SGRP and y positive to the right of the Vehicle centerline).

REMARKS:

HEADFORM IMPACT TEST RESULTS
SEAT BACKS

VEHICLE YEAR/MAKE/MODEL/STYLE:	2004 Pontiac Grand Prix 4-door Sedan
NHTSA NO.:	C40101
VIN:	2G2WS542X41171754
DATE OF MANUFACTURE:	08/03 (SEE CERTIFICATION LABEL)
COLOR:	White
ODOMETER READING:	37 miles
LABORATORY:	GD Engineering
TEST DATE:	May 3, 2004

IMPACT LOCATION AND NUMBER					VELOCITY (mph)	PEAK ACCELERATION (3 ms Clip) Gs
NUMBER		X (inches)	Y (inches)	ANGLE (degrees)		
1	Seat Back	-13.25	0	-8	14.6	28.65

REFERENCE POINT: SGRP on rear passenger side is the reference point (x positive forward from the front SGRP and y positive to the right of the Seat centerline).

SUN VISOR AND ARMREST EVALUATION

VEHICLE YEAR/MAKE/MODEL/STYLE:	2004 Pontiac Grand Prix 4-door Sedan
NHTSA NO.:	C40101
VIN:	2G2WS542X41171754
DATE OF MANUFACTURE:	08/03 (SEE CERTIFICATION LABEL)
COLOR:	White
ODOMETER READING:	37 miles
LABORATORY:	GD Engineering
TEST DATE:	July 13, 2004

SUN VISOR INFORMATION:

1. Are sun visors constructed of or covered with energy absorbing material?

   YES (PASS): X NO (FAIL): -

2. Are any edges statically contactable by a spherical 6.5 inch diameter headform of radius less than 0.125 inch?

   YES (FAIL): - NO (PASS): X

ARMREST INFORMATION:

A. FIXED ARMREST

1. Is it constructed of energy absorbing material with the capability of laterally deflecting 2 inches without contacting any underlying rigid material?

   YES: N/A NO: N/A

2. Is it constructed of energy absorbing material that deflects or collapses within 1.25 inches of the rigid test panel surface without contacting underlying rigid material between 0.50 and 1.25 inches from the panel which has a vertical height of less than 1 inch?

   YES: N/A NO: N/A

3. Does it provide adequate pelvic area impact protection?

   YES: X NO: -

4. Does it meet at least one of the criteria No. 1 to 3?

   YES (PASS): X NO (FAIL): -

B. FOLDING ARMREST

Is it made of or covered with energy absorbing material? Or does it meet at least one of the criteria No. 1 to 3?

YES (PASS): X NO (FAIL): -

DOOR LATCH EVALUATION

VEHICLE YEAR/MAKE/MODEL/STYLE:	2004 Pontiac Grand Prix 4-door Sedan
NHTSA NO.:	C40101
VIN:	2G2WS542X41171754
DATE OF MANUFACTURE:	08/03 (SEE CERTIFICATION LABEL)
COLOR:	White
ODOMETER READING:	37 miles
LABORATORY:	GD Engineering
TEST DATE:	July 13, 2004

LATCH ENGAGEMENT INTERFERENCE

DESCRIPTION OF LATCH LOCATION	NO LOAD	10G HORIZONTAL TRANSVERSE	10G VERTICAL	30G HORIZONTAL LONGITUDINAL
Glove Box	Pass	Pass	Pass	Pass
Center Console Arm Rest	Pass	Pass	Pass	Pass

(APPENDIX B CONTAINS CALCULATION SHEETS WHICH ARE BASED ON MANUFACTURER'S DATA)

SUMMARY OF RESULTS

VEHICLE YEAR/MAKE/MODEL/STYLE:	2004 Pontiac Grand Prix 4-door Sedan
NHTSA NO.:	C40101
VIN:	2G2WS542X41171754
DATE OF MANUFACTURE:	08/03 (SEE CERTIFICATION LABEL)
COLOR:	White
ODOMETER READING:	37 miles
LABORATORY:	GD Engineering
TEST DATE:	July 13, 2004

	NUMBER OF IMPACTS	PASS/FAIL
INSTRUMENT PANEL	3	Pass
SEAT BACK	1	Pass
SUN VISORS	n/a	Pass
ARMRESTS	n/a	Pass
INTERIOR COMPARTMENT DOORS	n/a	Pass

REMARKS:

APPENDIX A

PHOTOGRAPHS

PHOTOGRAPHS

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A-5	VEHICLE'S CERTIFICATION LABEL
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A-9	ARMREST LEFT REAR DOOR
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A-13	INSTRUMENT PANEL LEFT SIDE AIRBAG COVER IMPACT PRE-TEST
A-14	INSTRUMENT PANEL LEFT SIDE AIRBAG COVER IMPACT POST-TEST
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A-19	HEAD RESTRAINT
A-20	HEAD RESTRAINT IMPACT AREA PRE-TEST
A-21	HEAD RESTRAINT IMPACT AREA POST-TEST

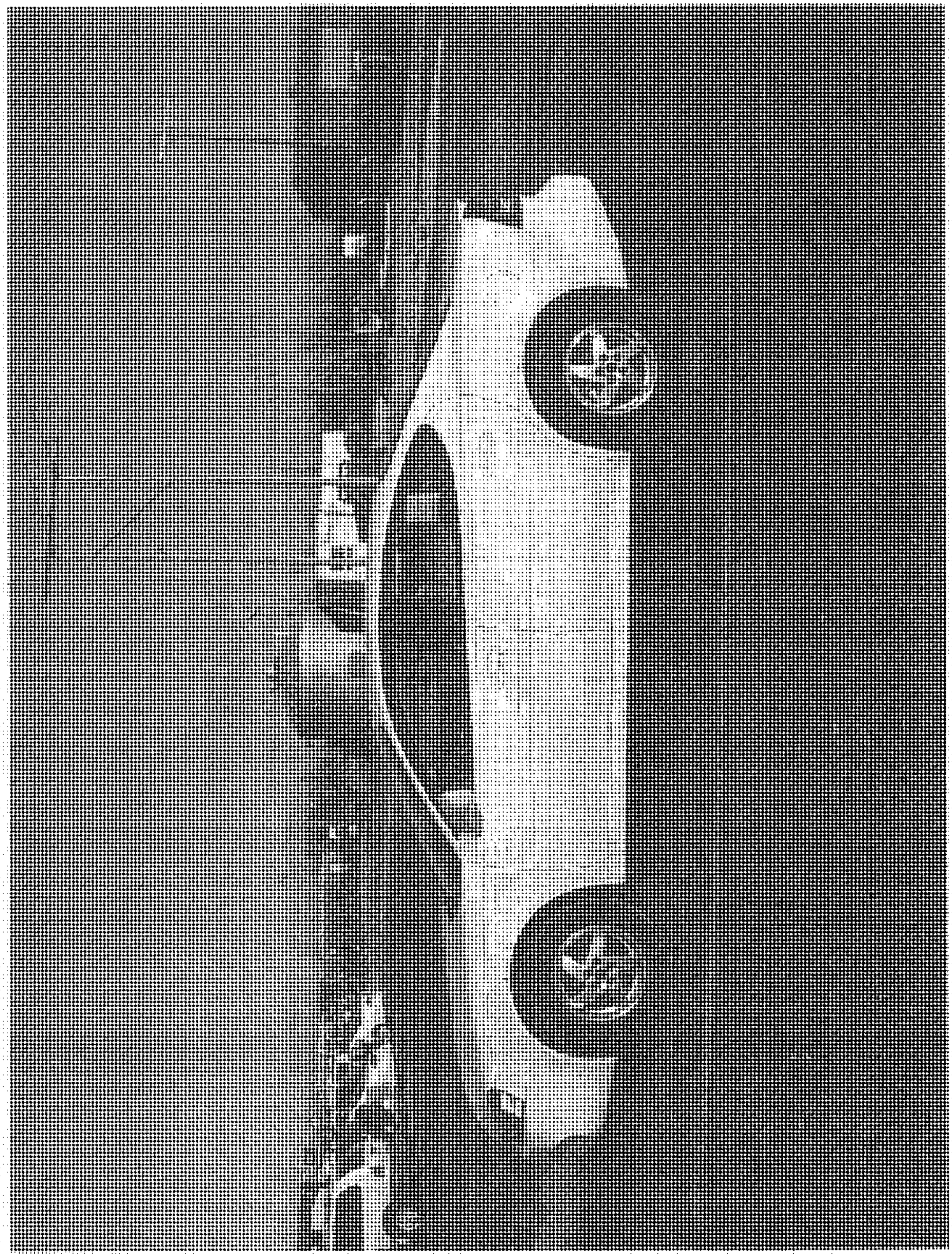


Figure A-1 : LEFT SIDE VIEW OF VEHICLE

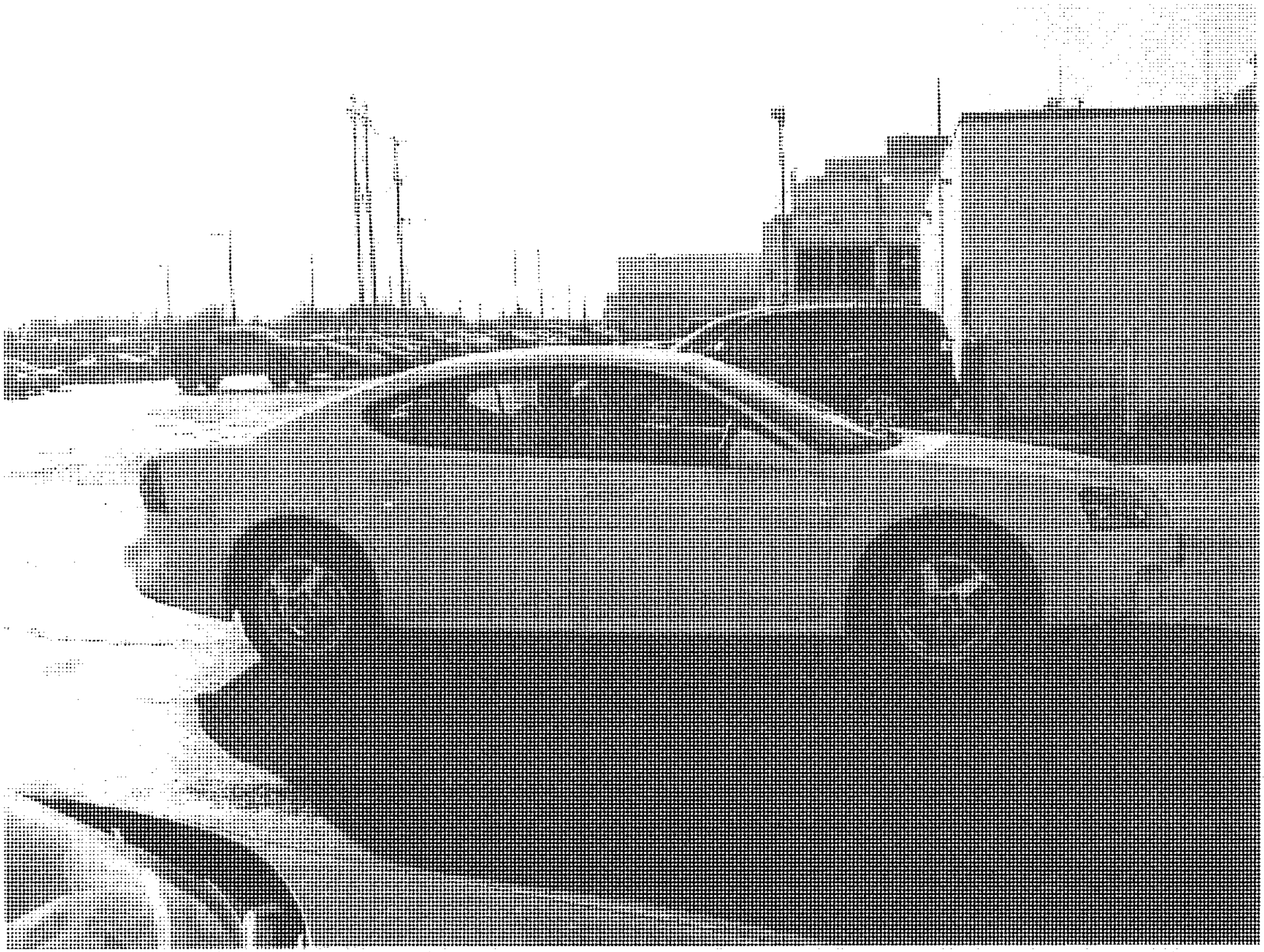


Figure A-2 : RIGHT SIDE VIEW OF VEHICLE

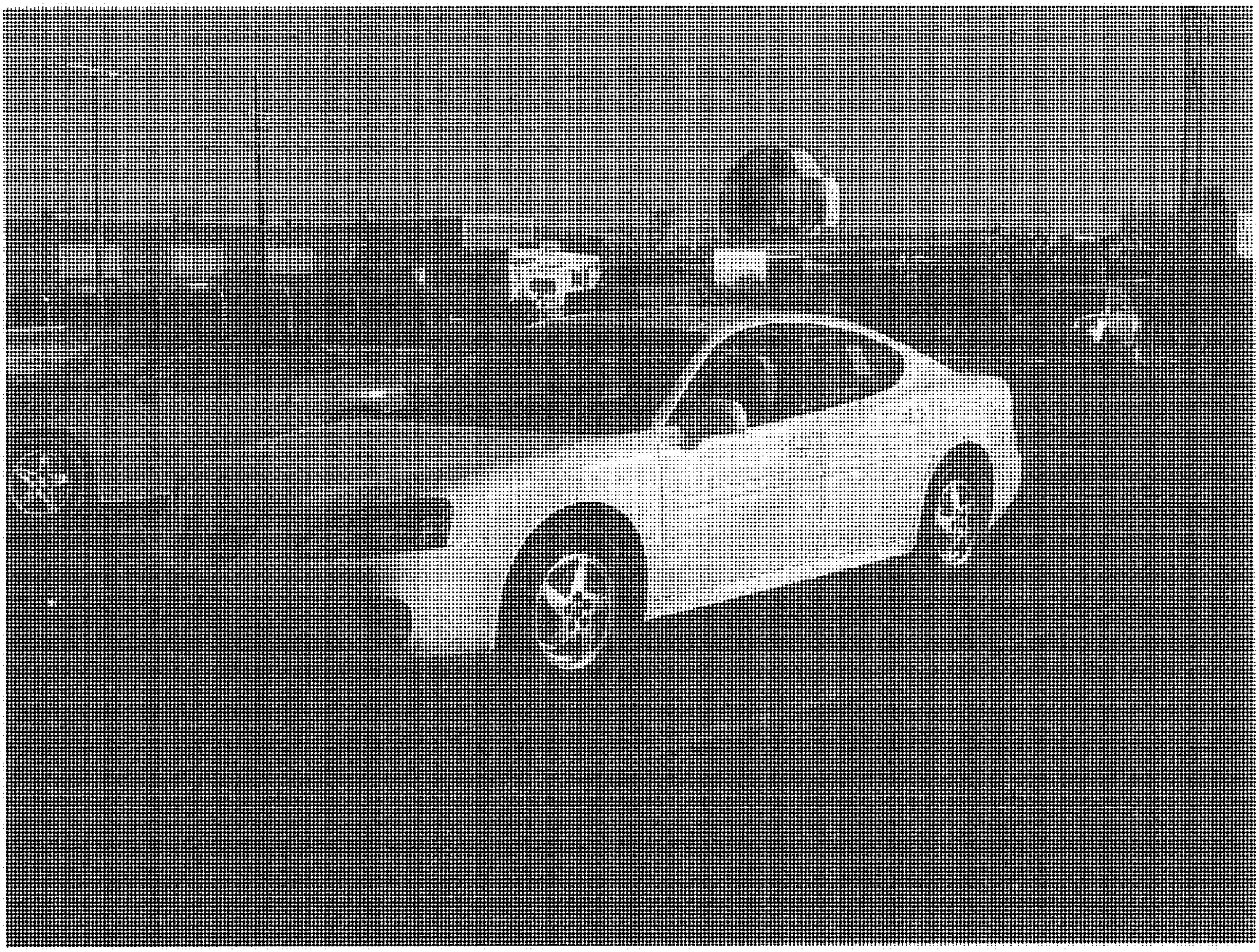


Figure A-3 : 3/4 FRONTAL VIEW FROM LEFT SIDE OF VEHICLE

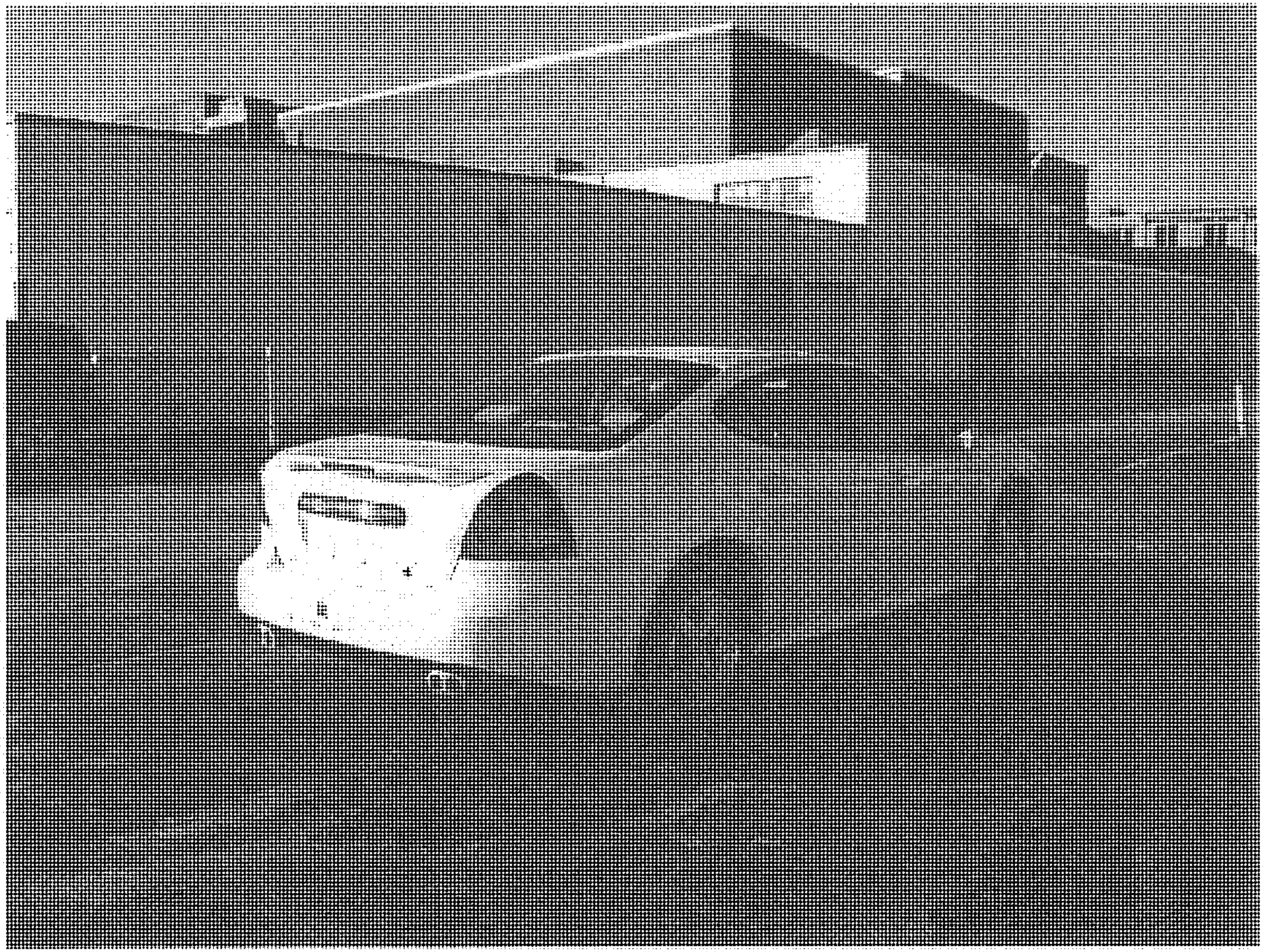


Figure A-4 : 3/4 REAR VIEW FROM RIGHT SIDE OF VEHICLE

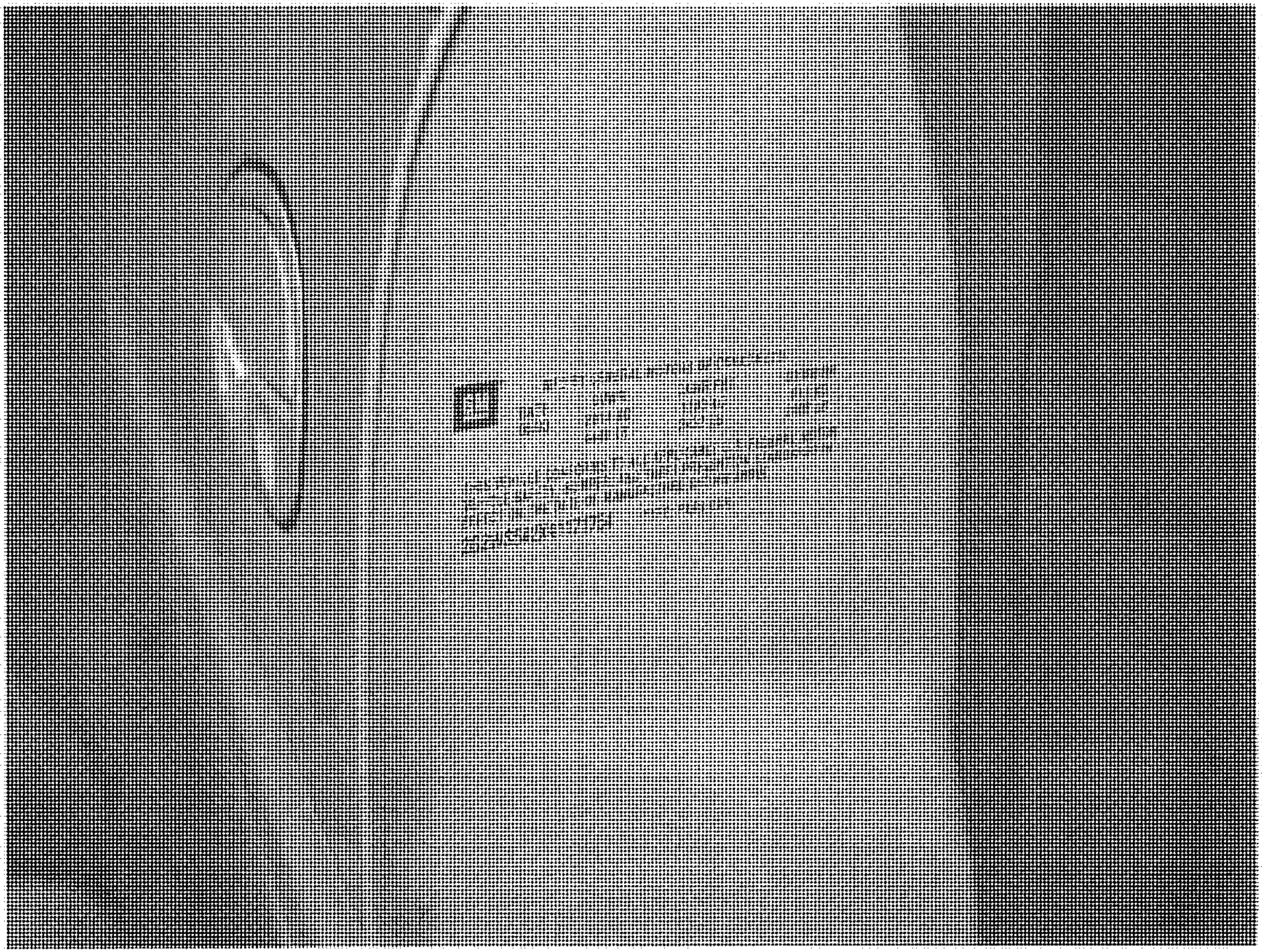


Figure A-5 : VEHICLE'S CERTIFICATION LABEL

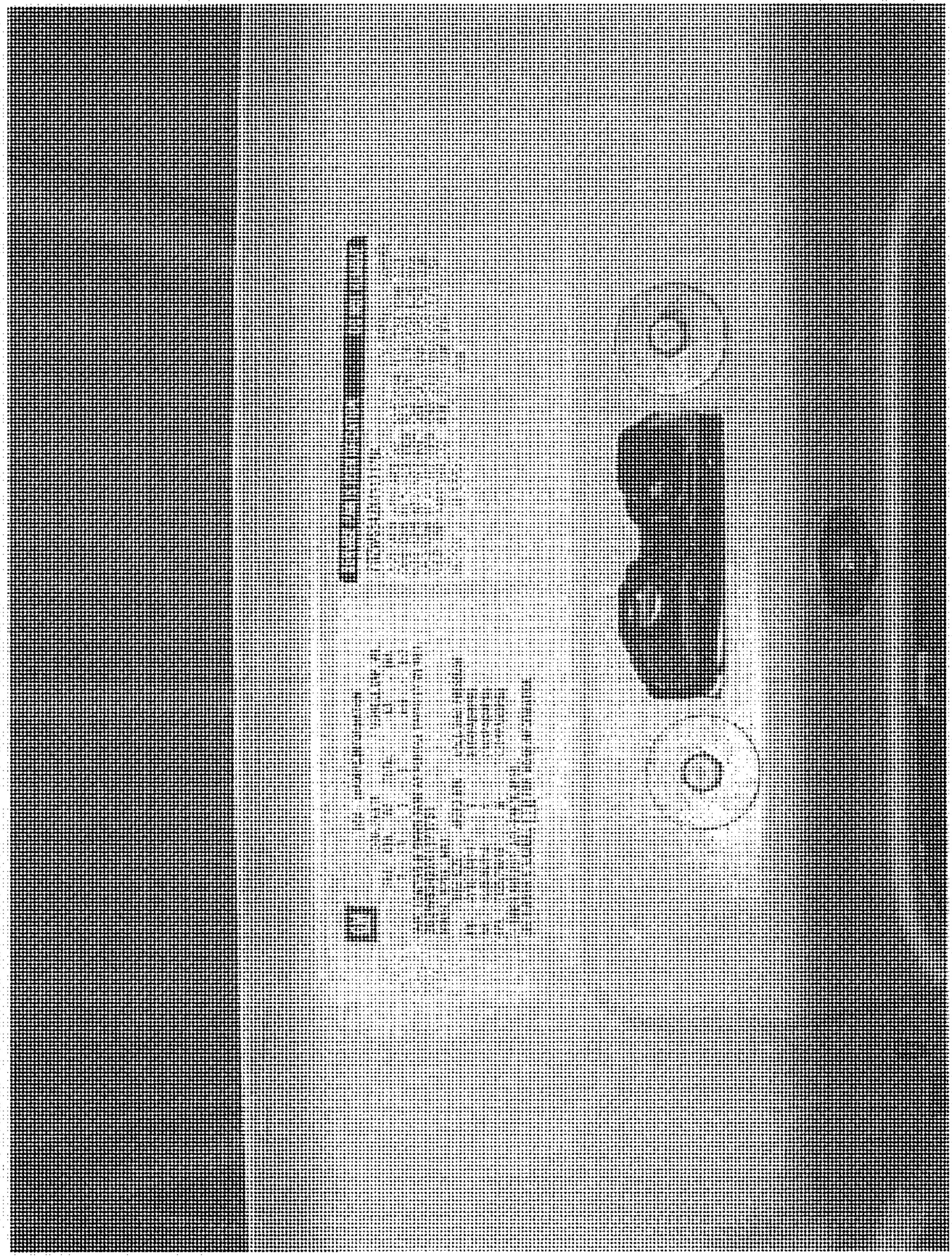


Figure A-5 : VEHICLE'S TIRE INFORMATION LABEL

Figure A-7   SUNVISOR CONSTRUCTION

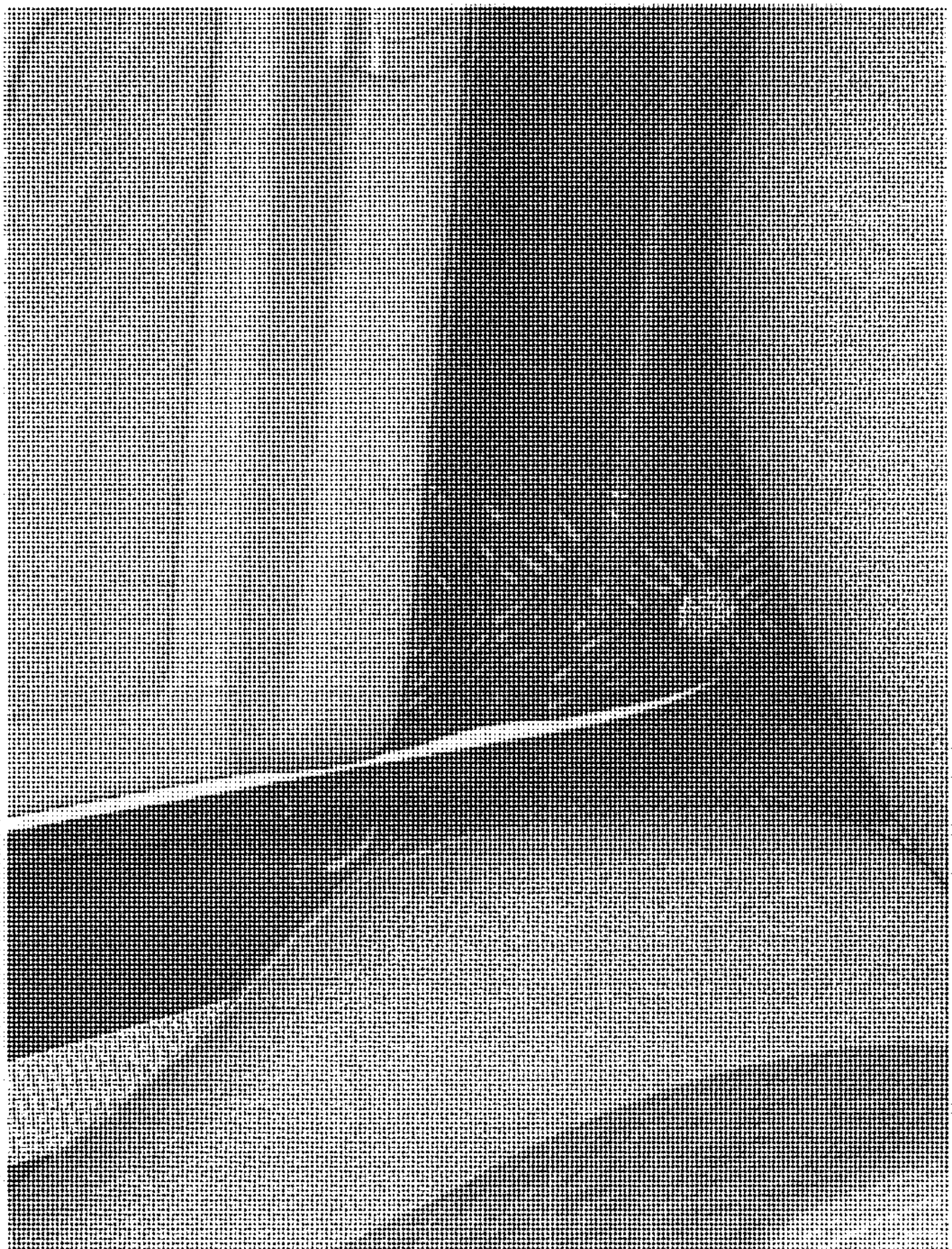


Figure A-8 : ARMREST LEFT FRONT DOOR

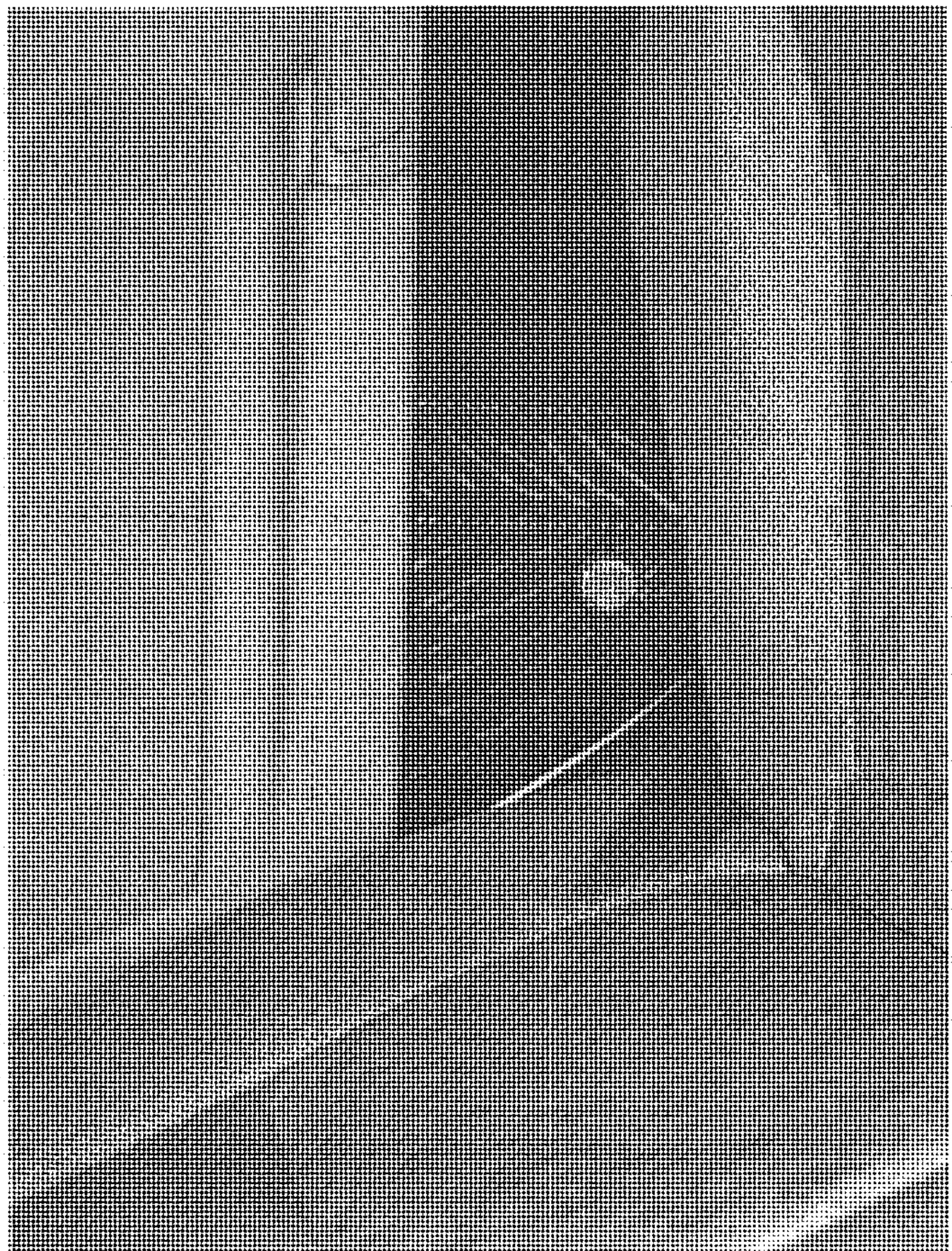


Figure A-9 : ARMREST LEFT REAR DOOR

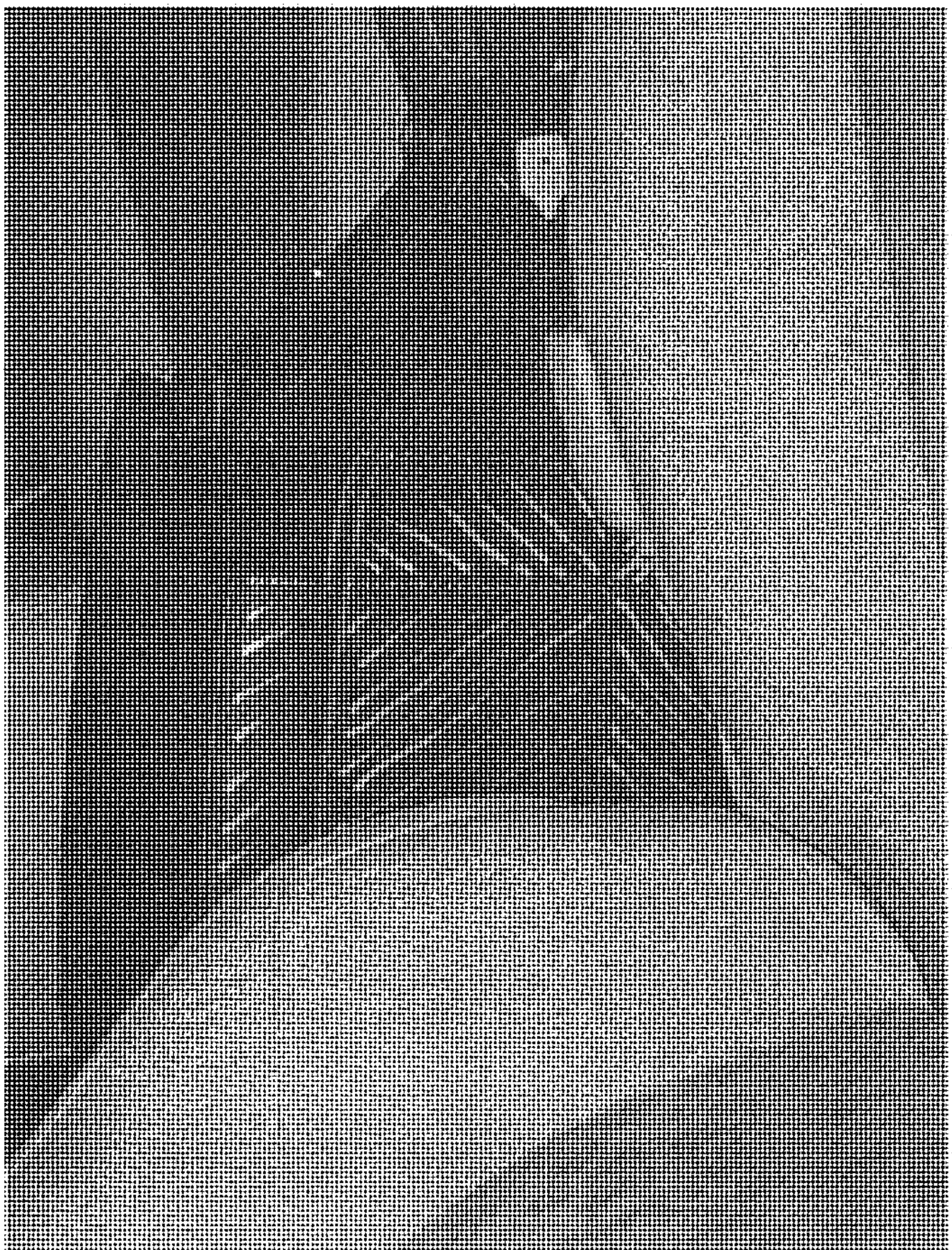


Figure A-10 · CONSOLE ARMREST

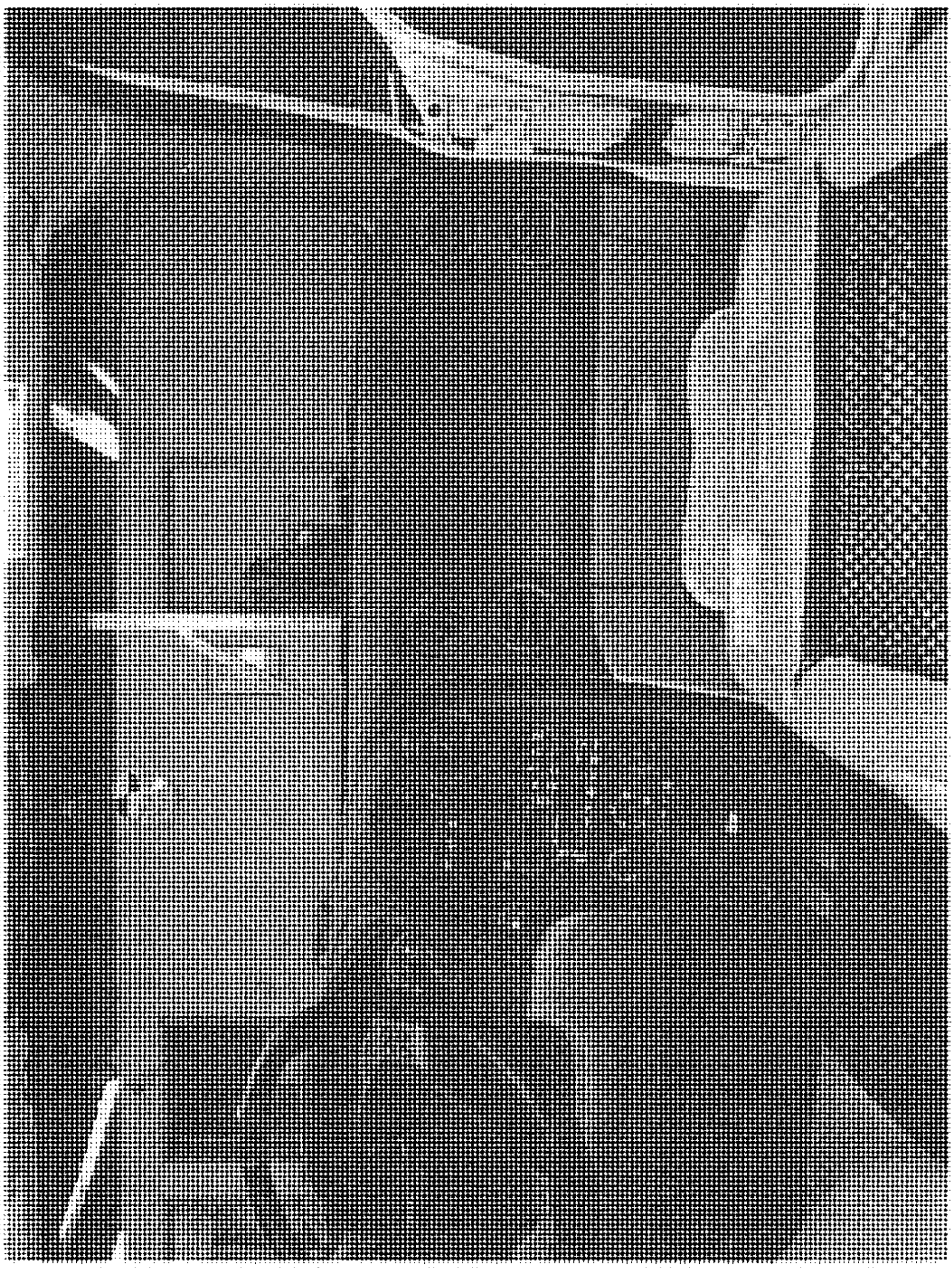


Figure A-13 : INSTRUMENT PANEL

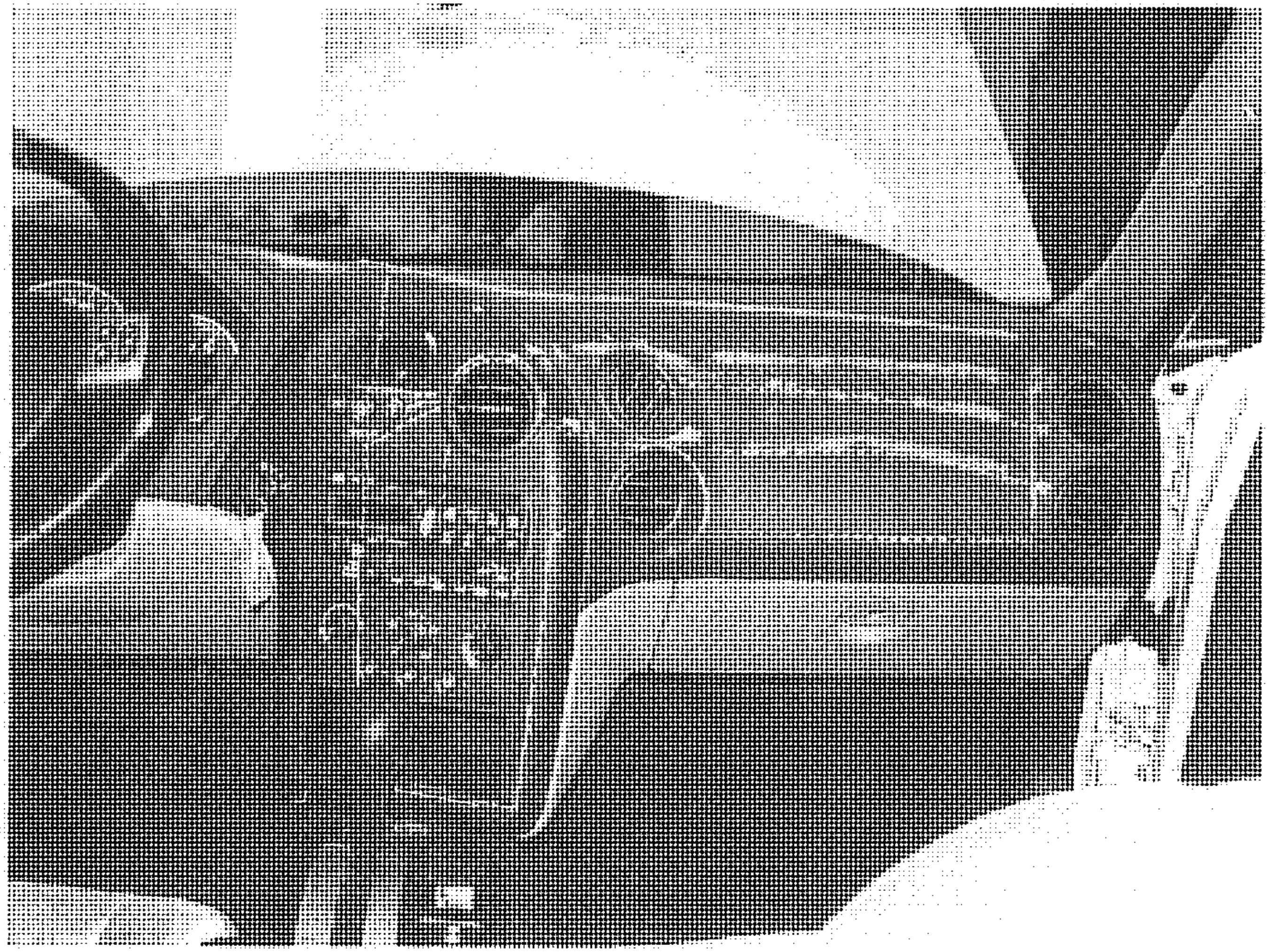


Figure A-12 : DELINEATED INSTRUMENT PANEL IMPACT ZONE PRE-TEST

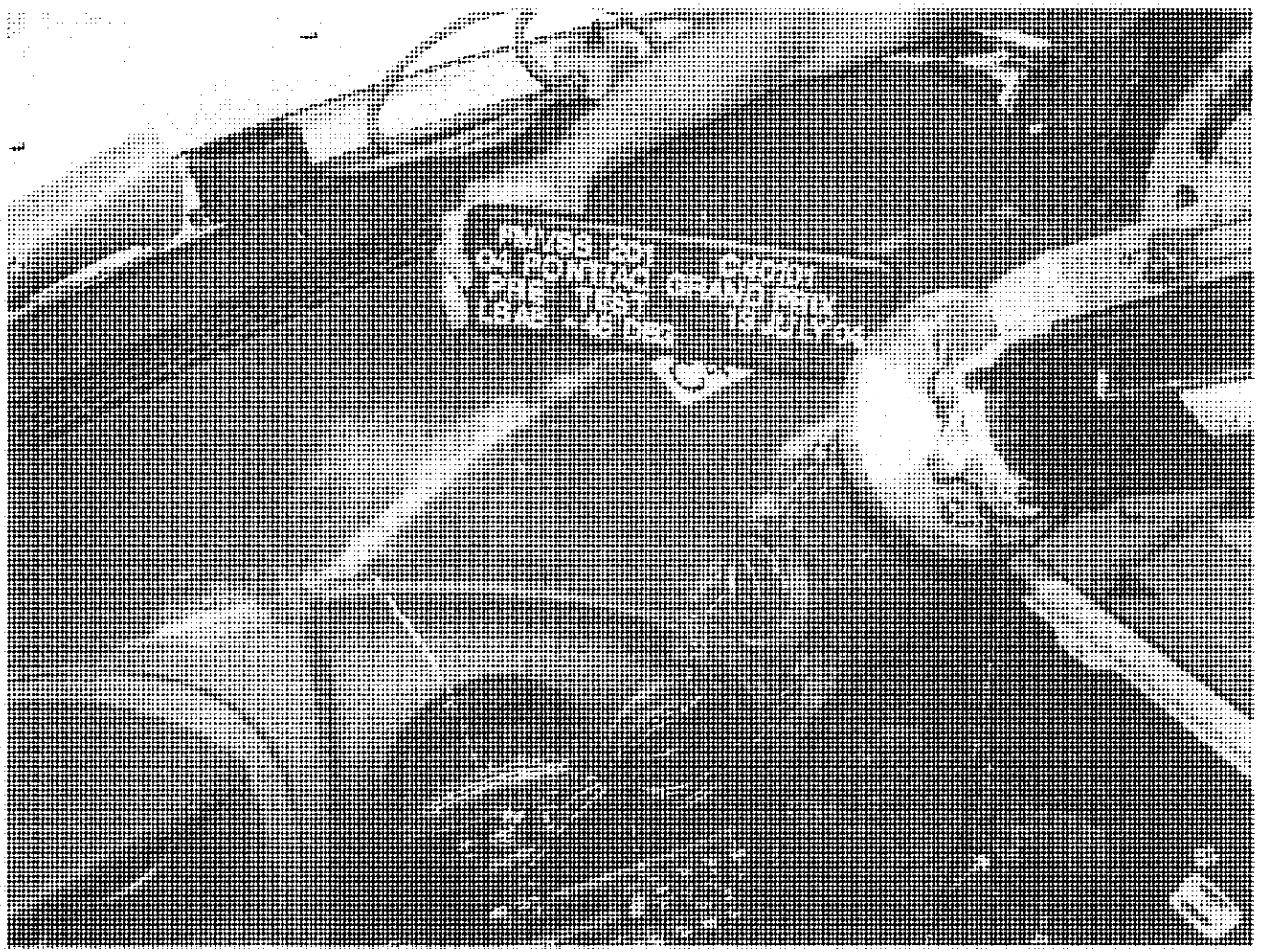


Figure A-13 : INSTRUMENT PANEL LEFT SIDE AIRBAG COVER IMPACT PRE-TEST

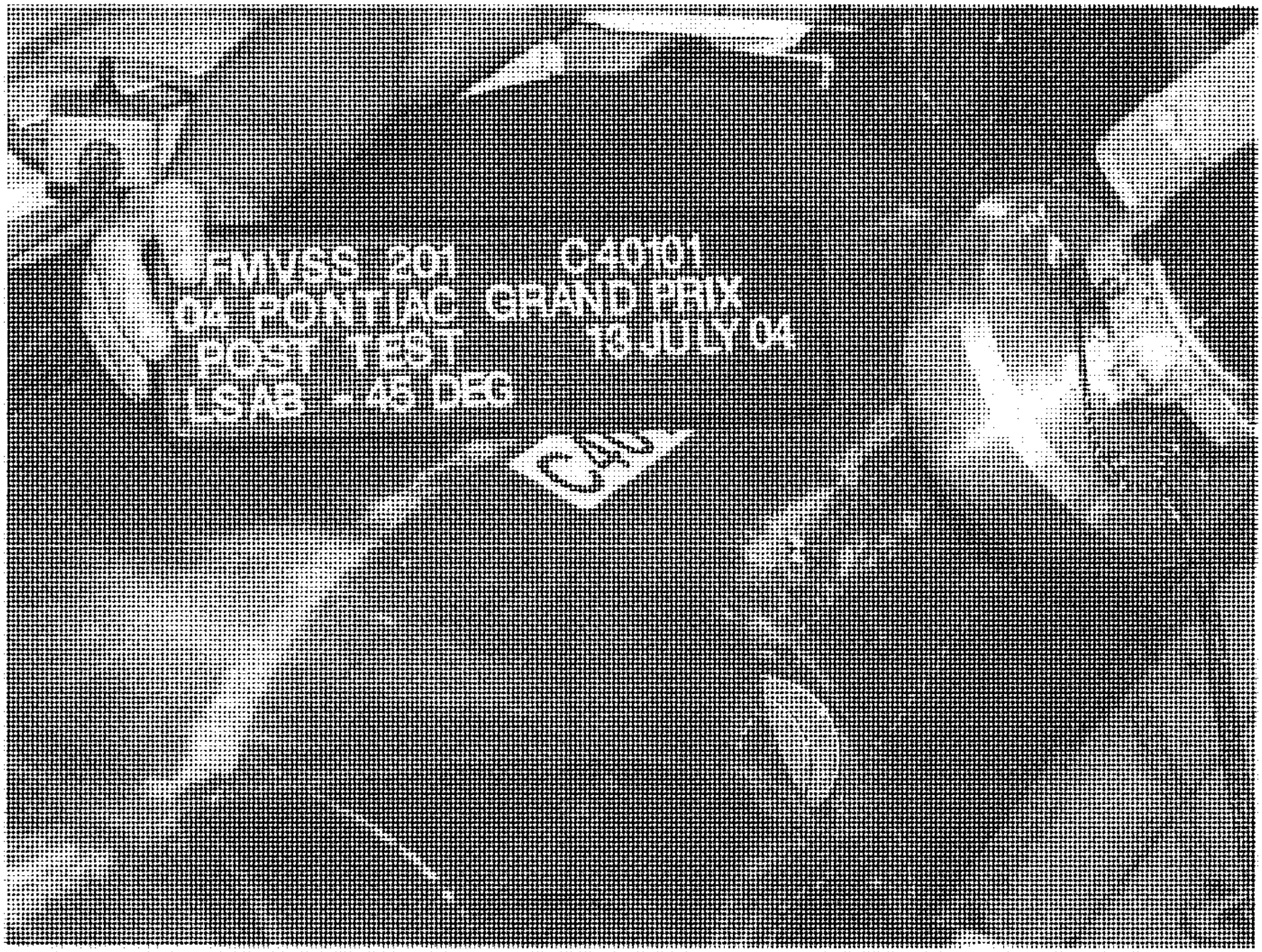


Figure A-14 : INSTRUMENT PANEL LEFT SIDE AIRBAG COVER IMPACT POST-TEST

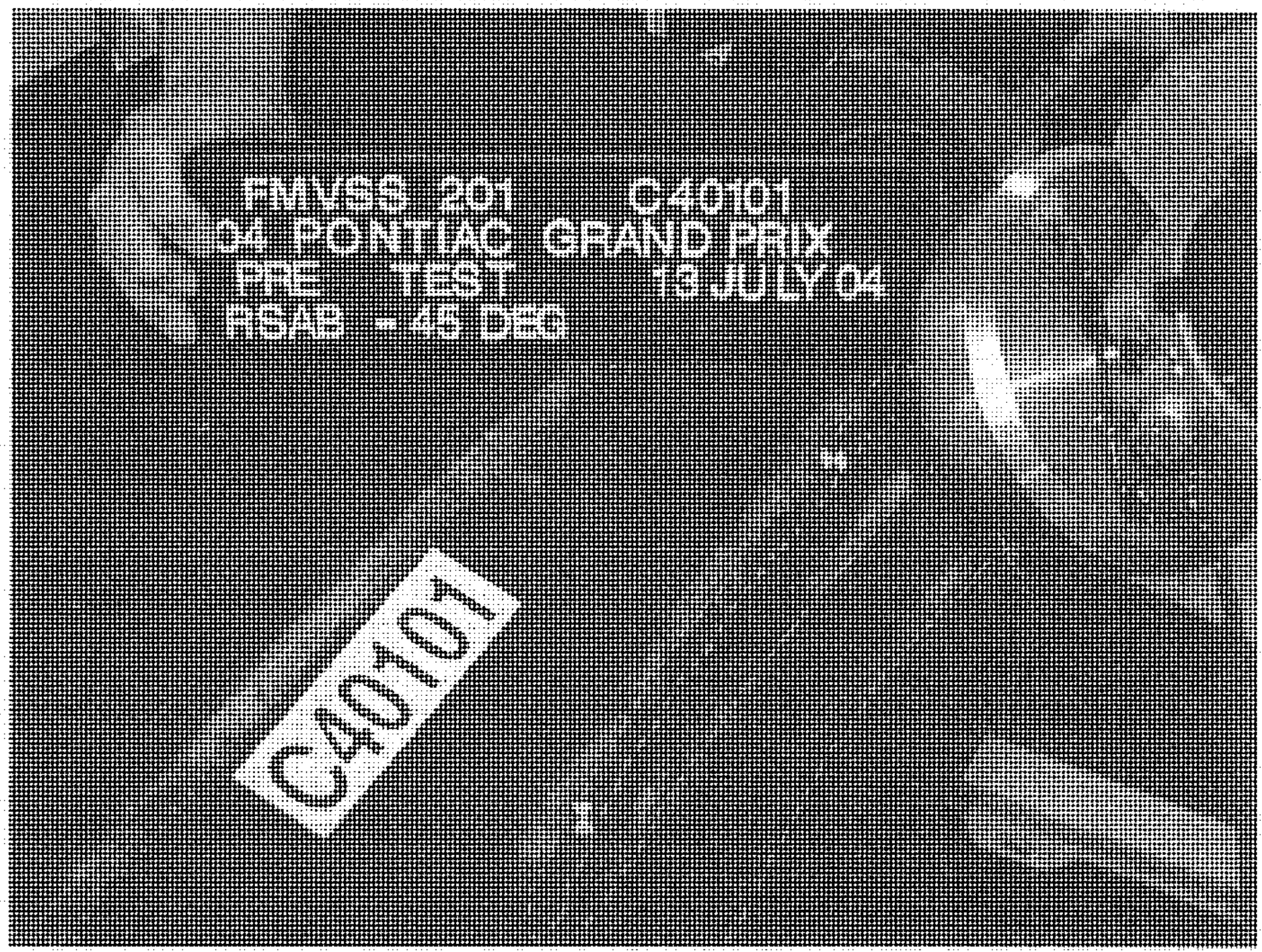


Figure A-15 : INSTRUMENT PANEL RIGHT SIDE AIRBAG COVER IMPACT PRE-TEST

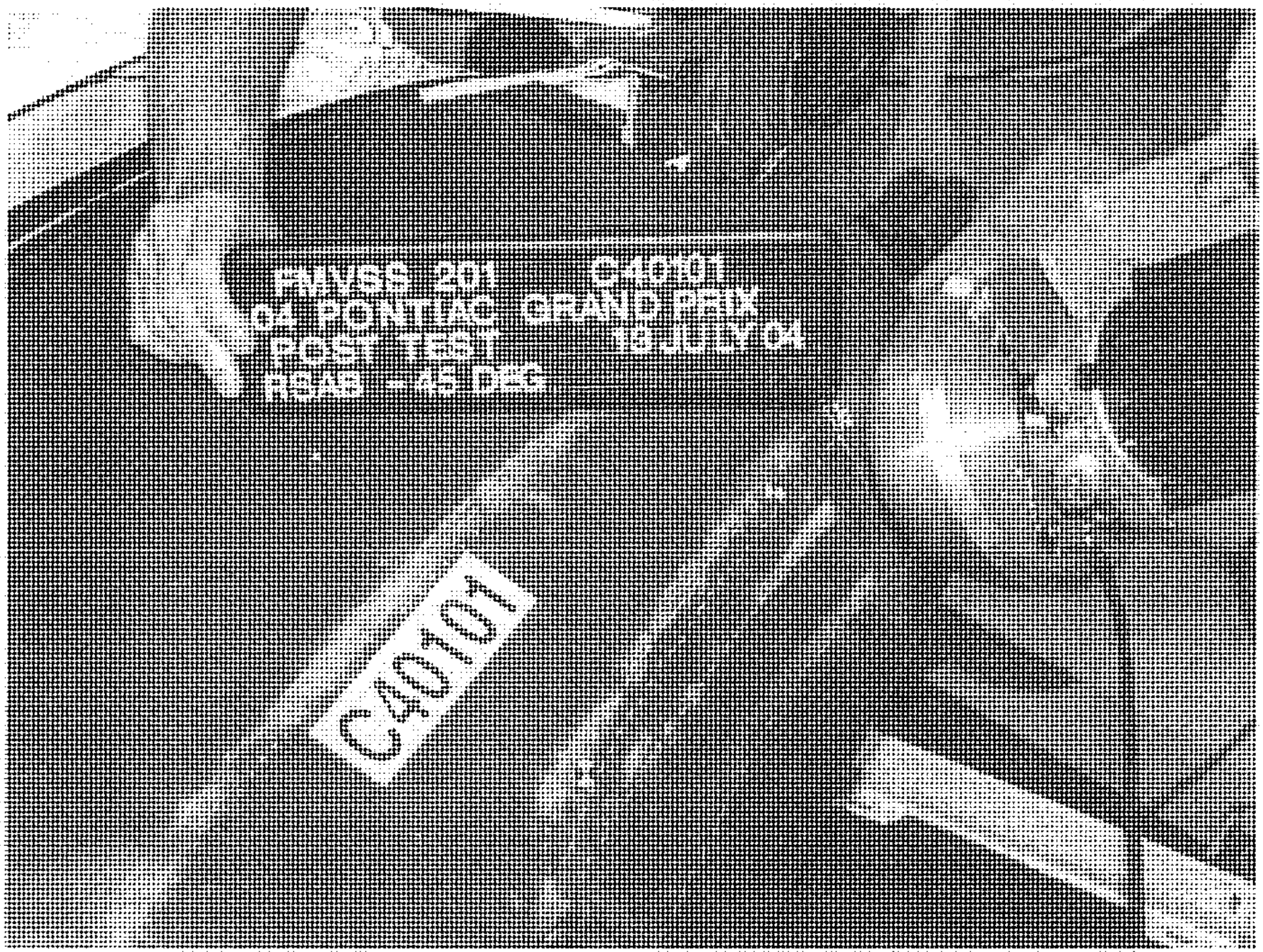


Figure A-16 : INSTRUMENT PANEL RIGHT SIDE AIRBAG COVER IMPACT POST-TEST

Figure A-17 INSTRUMENT PANEL CONSOLE VENT IMPACT PRE-TEST

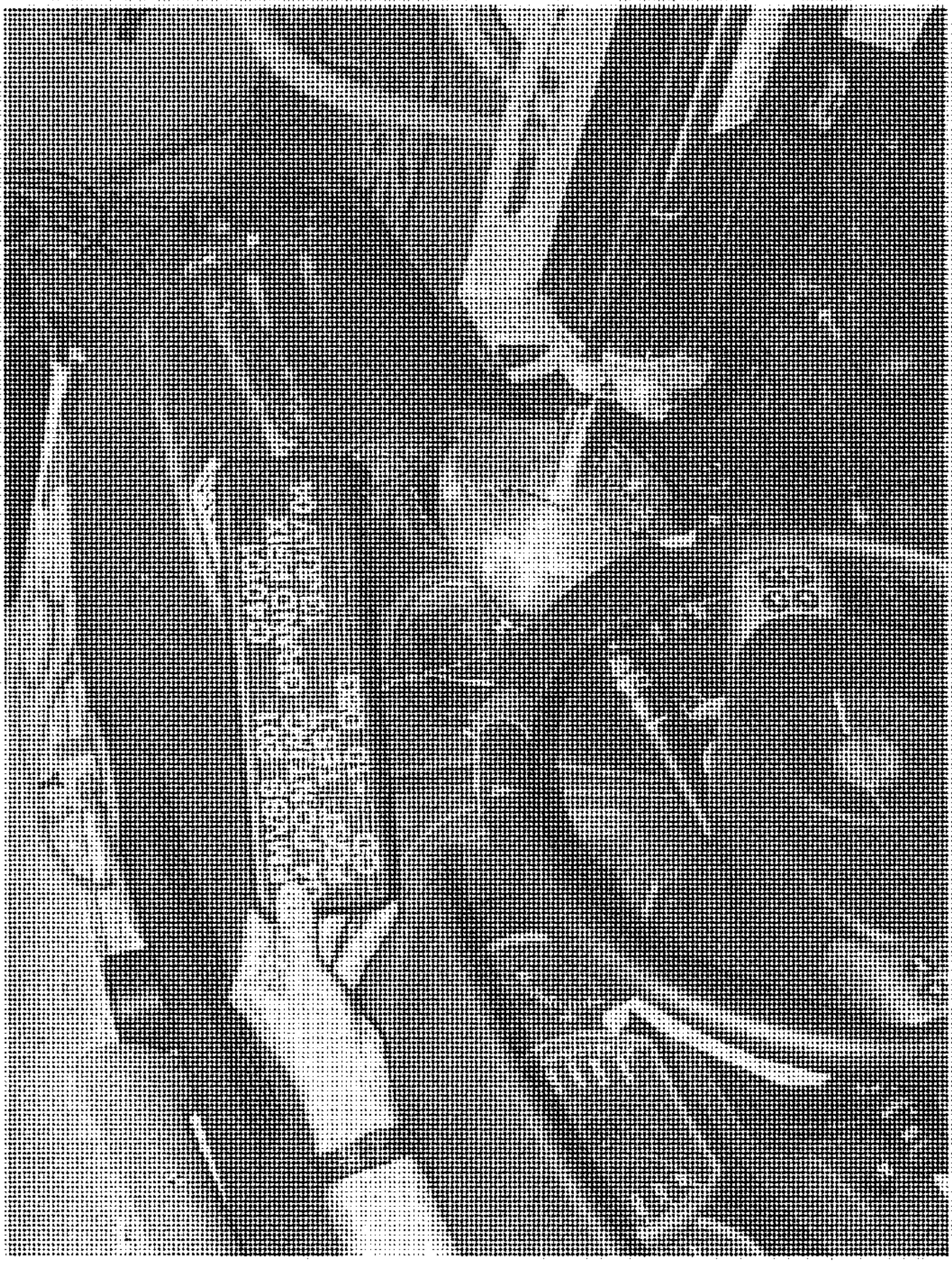


Figure A-38 : INSTRUMENT PANEL CONSOLE VENT IMPACT POST-TEST

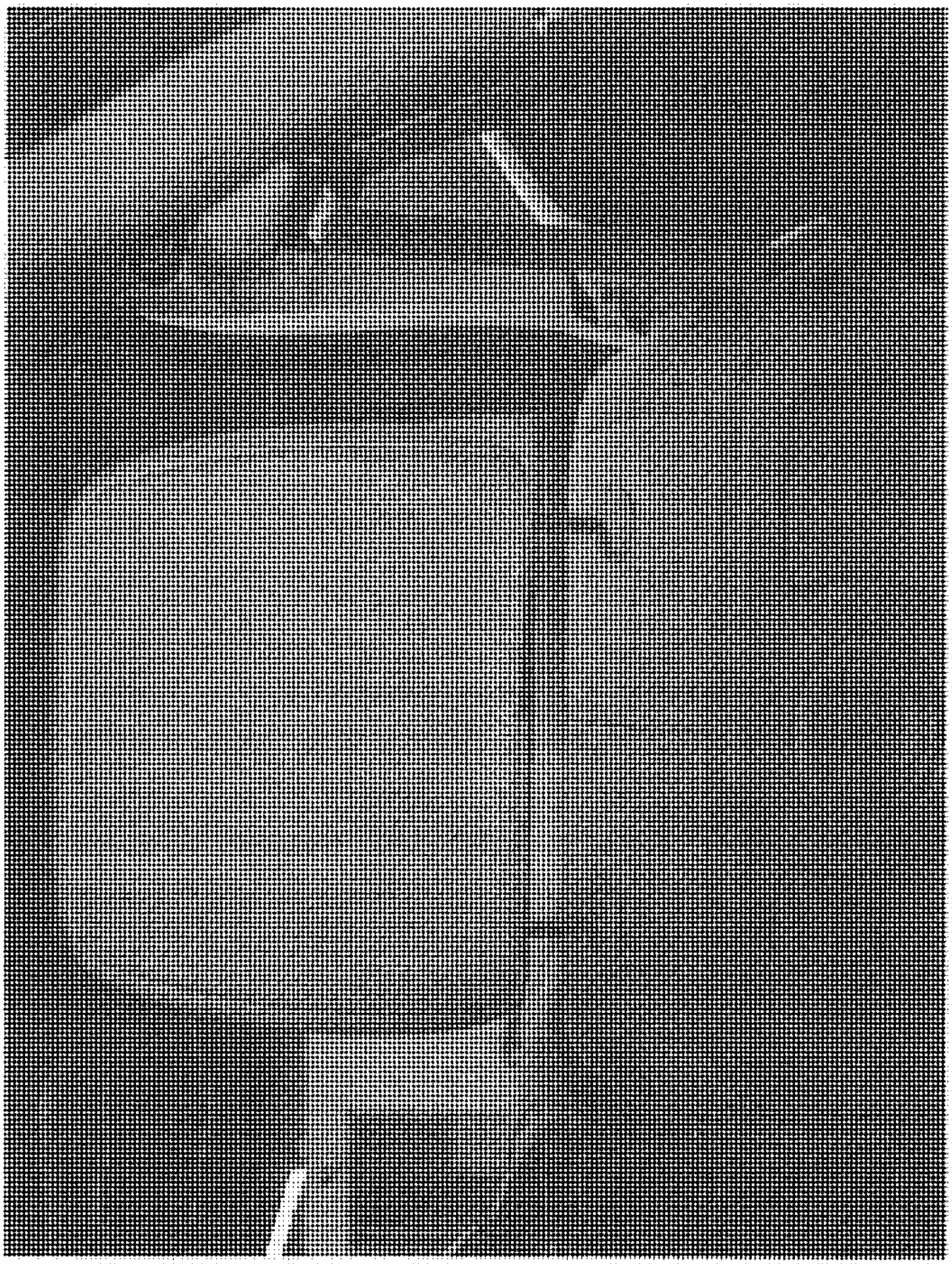


Figure A-19: HEAD RESTRAINT

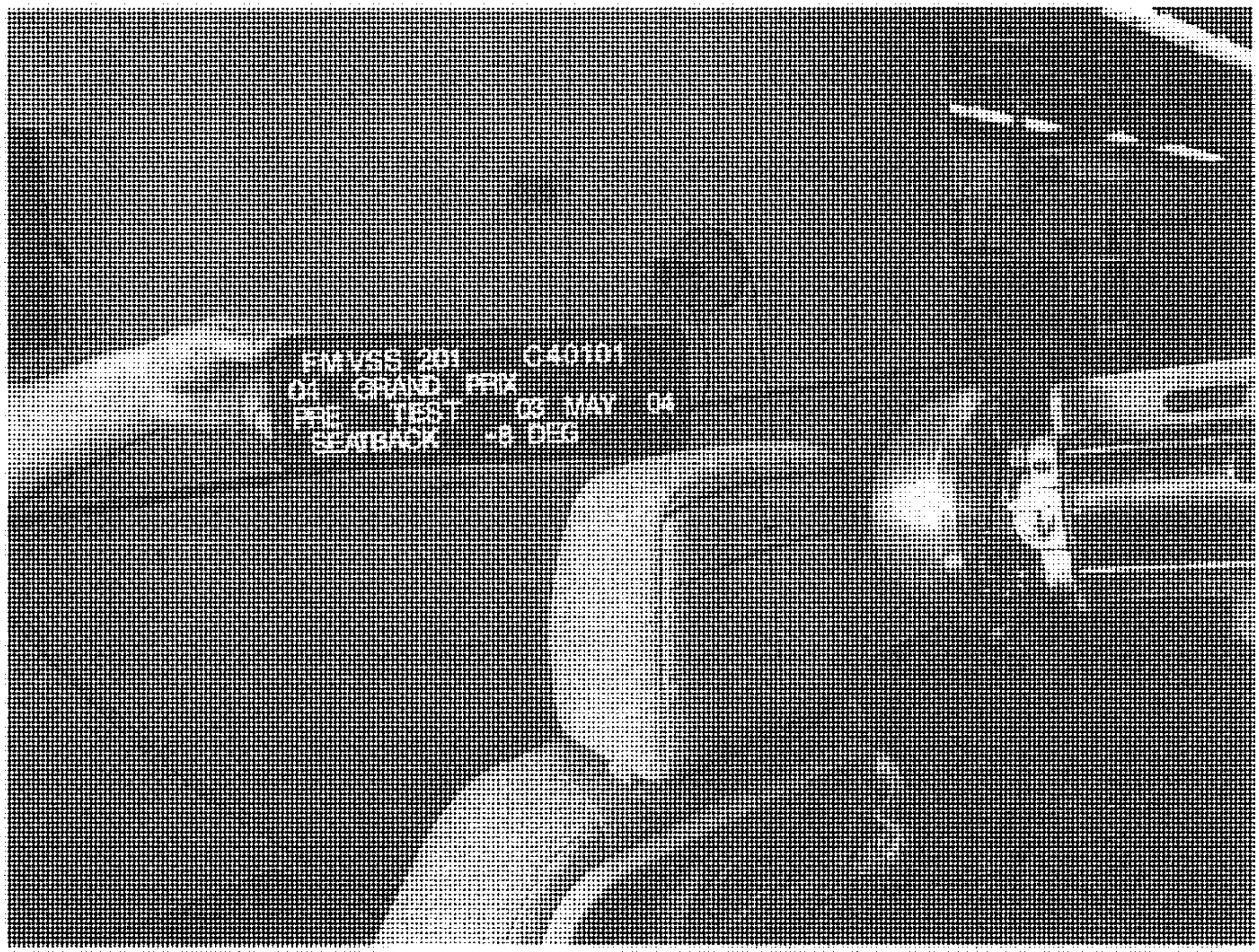


Figure A-20 · HEAD RESTRAINT IMPACT AREA PRE-TEST

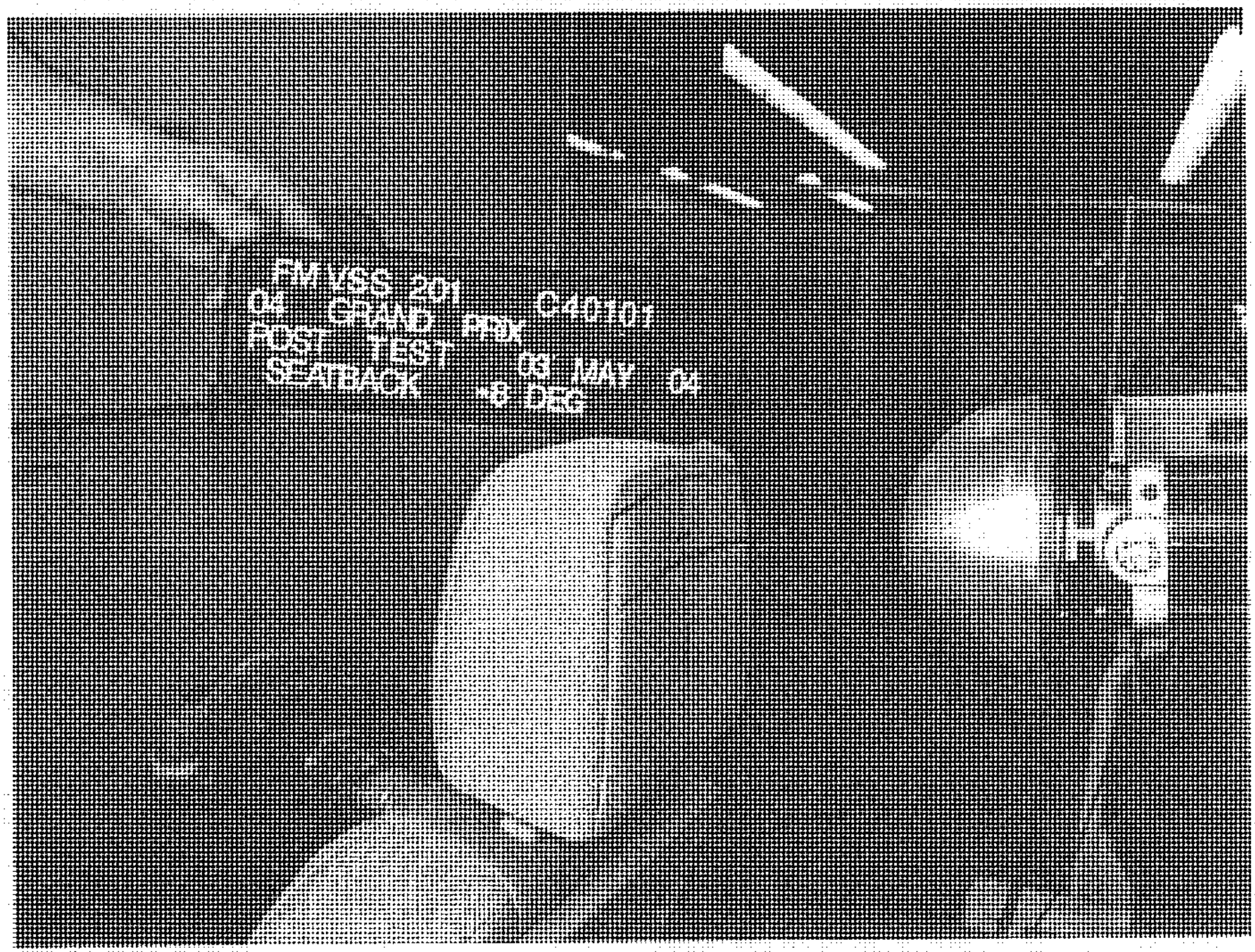


Figure A-21 : HEAD RESTRAINT IMPACT AREA POST-TEST

APPENDIX B

INTERIOR COMPARTMENT DOOR CALCULATIONS

FORM 5

FMVSS No. 201
Latch Component Analysis Information

Latch component inertial analysis information for each interior compartment door assembly located in an instrument panel, console assembly, seat back, or side panel adjacent to a designated seating position in accordance with the procedure described in section 5/of SAE Recommended Practice J839b, "Passenger Car Side Door Latch Systems."

Such data shall include:

1. Geometric details of the latch/lock configuration.

Geometric details of the latch/lock configuration can be found in the attached FMVSS 201 Compliance Documentation for the 2004 Pontiac Grand Prix:

Console Door	**TWO 04WC0-593**	**Attachment 1**
Glove Box Door	**TWO 04WC0-594**	**Attachment 2**

2. Mass data for each element in the linkage.

Mass data for each element in the linkage can be found in the attached FMVSS 201 Compliance Documentation for the 2004 Pontiac Grand Prix:

Console Door	**TWO 04WC0-593**
Glove Box Door	**TWO 04WC0-594**

3. Spring rates for each spring element in the configuration.

Spring rates for each spring element in the configuration linkage can be found in the attached FMVSS 201 Compliance Documentation for the 2004 Pontiac Grand Prix:

Console Door	**TWO 04WC0-593**
Glove Box Door	**TWO 04WC0-594**

4. Any additional details unique to the design yet necessary for the calculations.

Any additional details unique to the design linkage can be found in the attached FMVSS 201 Compliance Documentation for the 2004 Pontiac Grand Prix:

Console Door	**TWO 04WC0-593**
Glove Box Door	**TWO 04WC0-594**

Attachment 1

TWO 04WC0-594-00 – 2004 Pontiac Grand Prix Compliance to FMVSS 201 Lower Latching Requirements

2004 Grand Prix Glove Box Door Latch Calculations

CG190 (Rev. April_2002) GM CONFIDENTIAL

GM

GM Evaluation Report

Platform	Project/EWO No.	Requirement No.	Procedure No.	VPP/VIA/UPC	Model Year	Model No.	PER/Report No.
PONTIAC GRAND		FMVSS 201L	0000	1A 2B	2004	GMX367	04WC0-594-00

Int. Reg. No. FMVSS 201L Category: VPA - Vehicle Product Assurance

Function: ☐ Development ☑ Validation
Method: ☐ Math Based ☑ Hardware Based

Date: 14/Oct/2002
Title: OCCUPANT PROTECTION-COMPARTMENT DOOR LATCHING

☑ Final
☐ Interim No.
☐ Reissue Date of Reissue:

To (Requestor): N/A
From: ALICIA SOPALA

Date of Request: 14/Oct/2002
Dates of Evaluation:

Objective: Report generated to document compliance of the 2004 GMX367 Pontiac Grand Prix car to FMVSS 201 lower latching requirements.

Conclusions: 2004 GMX367 Pontiac Grand Prix cars are in compliance with FMVSS 201 lower latching requirement.

Recommendations: None.

Design Evaluated: **GMUTS Rating:** **Veh Mileage:**

Part/Test Object Name(s)	Veh/Buck/PT/PartNo./RPO:	Revision Date/Level

Distribution:

Name: N/A Loc: N/A
Name: Loc:
Name: Loc:
Name: Loc:
Name: Loc:

Cc:

Alicia Sopala
Author: Alicia Sopala Date 16-Oct-2002
(Title/ Phone) Validation Egr. 586-986-4866
(Location) 480-111-W15

Keith Nelson
Approver: Keith Nelson Date Oct 17, 2002
(Title) Validation EGM 586-986-5735
(Location) 480-111-S28

Approver: Not Required Date N/A
(Title)
(Location)

GM

GM Evaluation Report

Platform	Project/EWO No.	Requirement No.	Procedure No.	VPP/VIA/UPC	Model Year	Model No.	PER/Report No.
PONTIAC GRAND		FMVSS 201L	0000	1A 2B	2004	GMX367	04WCO-594-00

Int. Reg. No. FMVSS 201L Category: VPA - Vehicle Product Assurance

Recommendations (Expanded): None.

Foreword: N/A

Requirements:
MVSS Legal Requirement LV.201

Background: N/A

Assumptions/Limitations: N/A

Analysis Model: N/A

Equipment:

None

Procedure/Method:
L2-1A2B-201G

Results:
See attached

Reference Issue Report (PIMREP / PRTS): N/A

References/File Storage: N/A

Calibration Report Information: N/A

Appendix:
The 2004 GMX367 Sedan Glove Box Door Latch Calculations.

PRODUCT VERIFICATION (THEORETICAL)		
SPECIFICATION: FMVSS-201	CUSTOMER P/N: NCT P/N: 7011-ASM	ISSUE DATE: Mar. 22, 2002
CUSTOMER: General Motors Corp. / Johnson Controls Inc.		PAGE 1 of 5

Analysis of '04 GMX 367 Glove Compartment Latch

OBJECTIVE:

To verify that the '04 GMX 367 Glove Compartment Latch Assembly meets the MVSS-201 inertia load requirements.

RESULTS:

30 G's in Negative Longitudinal direction: The Latch mechanism complies with MVSS-201 requirements. Analysis indicates that a minimum total moment of 422 N•mm is acting to force the mechanism in the closed position.

30 G's in Positive Longitudinal direction: The Latch mechanism complies with MVSS-201 requirements. Analysis indicates that a minimum total moment of 213 N•mm is acting to force the mechanism in the closed position.

10 G's in Negative Vertical direction: The Latch mechanism complies with MVSS-201 requirements. Analysis indicates that a minimum total moment of 353 N•mm is acting to force the mechanism in the closed position.

10 G's in Positive Vertical direction: The Latch mechanism complies with MVSS-201 requirements. Analysis indicates that a minimum total moment of 283 N•mm is acting to force the mechanism in the closed position.

10 G's in Horizontal Transverse direction: Since the Latch hinge axis lies in the transverse direction, transverse deceleration loading does not cause any additional opening moments on the latch mechanism assembly. The lateral acceleration forces are along the rotating axis of the Handle. These Loads have been set to zero in this analysis.

SOLUTION METHOD:

The 30 G and 10 G acceleration forces were converted to static forces by applying the respective accelerations to the Center of Gravity. These forces, translated into moments about the hinge point and combined with the moment from the torsion spring, were used to perform a summation of moments about the hinge point. A resulting moment that tends to force the mechanism further into the latched position suggests that the latch-mechanism assembly complies with the MVSS-201 requirements.
The inertial effects on the Glove-Compartment door will generate some load on the pawl and will effect the moment summation calculation. Since the analysis showed that a passing condition was already present without considering friction contributors, it was not necessary to include them in the calculation. The Pawl was included but treated separately since the Pawl is suspended independent of the Handle-assembly. The Handle-motion is been captured within 2° by the Pawl and therefore had to be added to the Summation Calculation.

CUSTOMER CONCURRENCE:	

Revised by Derek Burkhart
3M P/N: 10324674/75
Glove-Box Latch Assembly

REVISION: A 09/06/00

PRODUCT VERIFICATION (THEORETICAL)		
SPECIFICATION: FMVSS-201	CUSTOMER P/N: NCT P/N: 7011-ASM	ISSUE DATE: Mar. 22, 2002
CUSTOMER: General Motors Corp. / Johnson Controls Inc.		PAGE 2 of 5

DISCUSSION/CALCULATIONS:

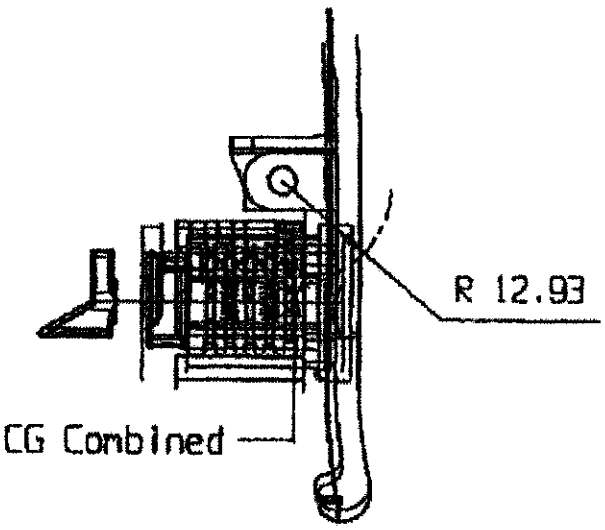
Determination of the Mass and Center of Gravity.

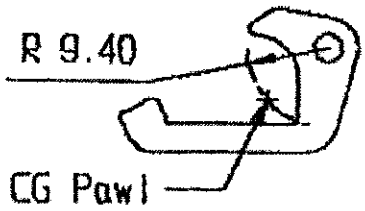
mass Handle = 19.3 g

mass Cylinder = 5.9 g

mass Handle Total = 25.2 g

mass Pawl = 3.22 g





The CG location of the Components and Mass properties were determined by CADKEY's and Solidmodeler.

Note:

Special consideration has been taken to cover all possible Build variations. Worst case X-Y CG displacement has been measured as the Radius of 12.93mm, and 9.40mm for the Pawl.

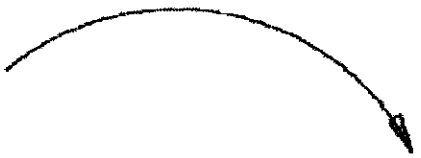
Revised by Derek Burkhart
GM P/N: 10324874/75
Glove-Box Latch Assembly

REVISION: A 09/06/00

PRODUCT VERIFICATION (THEORETICAL)		
SPECIFICATION: FMVSS-201	CUSTOMER P/N: NCT P/N: 7011-ASM	ISSUE DATE: Mar. 22, 2002
CUSTOMER: General Motors Corp. / Johnson Controls Inc.		PAGE 3 of 5

Computation of Torque generated by the Torsion Spring

$$M = \frac{Ed^4T}{10.8ND}$$



Torque for a given single torsion spring can be found by:

M = Moment of Torque(lb•in)

E = Modulus of Elasticity = 30xE6 PSI

d = Diameter of Spring wire = 0.050"

T = Deflection (revolutions) = 11°/360° *(33°/360°)*

N = Number of Coils = 4.5 *(3.5)*

D = Mean Coil Diameter = 0.200"

This yields:

Handle Torque

M = [(30E6 x 0.050"^{4} x 0.03056] / [(10.8 x 4.5) x 0.200"]

M = 0.59 Lbs•In x 113

M = 66.67 N•mm acting clockwise onto Handle-assembly

Pawl Torque

M = [(30E6 x 0.050"^{4} x 0.09167] / [(10.8 x 3.5) x 0.200"]

M = 2.255 Lbs•In x 113

M = 254.82 N•mm acting clockwise onto Pawl-assembly

REVISION: A 09/06/00

Revised by Derek Burkhart
GM P/N: 10324674/75
Glove-Box Latch Assembly

PRODUCT VERIFICATION (THEORETICAL)		
SPECIFICATION: FMVSS-201	CUSTOMER P/N: NCT P/N: 7011-ASM	ISSUE DATE: Mar. 22, 2002
CUSTOMER: General Motors Corp. / Johnson Controls Inc.		PAGE 4 of 5

Summation of Forces and Moments Due to Acceleration

Horizontal Longitudinal Directions

Values in *( )* relate to Pawl-section
30 G's - An inertial force generated by 30 G on the handle (Handle = 25.2 grams) can be found by:
(Pawl = 3.22 grams)

$F = m \times s$
$F = 25.2gr.\{3.22gr.\} \times (30\ G \times 9.807\ m/s^2) = 7414.09g \cdot m/s^2\ \{947.36g \cdot m/s^2\}$
$F = 7414.09g \cdot m/s^2\ \{947.36g \cdot m/s^2\} \times 0.001$
$F = 7.41$ Newtons *{0.95 Newtons}*

1 G Negative Vertical Direction of Parts – $247.13g \cdot m/s^2\{31.579g \cdot m/s^2\} \times 0.001 = 0.24$Newton*{0.032N}*

30 G's applied in Positive Longitudinal direction

Taking clockwise as positive, the inertial force, F is applied horizontally at the CG and generates a positive moment about the hinge point across the moment arm formed by the radial offset "R".

$\Sigma M = [(F \times R) - M] + (1G_{Handle} \times R)$
$\Sigma M = [(7.41N\{0.95N\} \times 12.93mm\{9.4mm\}) - 66.67N \cdot mm\{254.82N \cdot mm\} + (0.24N\{.032N\} \times 12.93mm\{9.4mm\})$
$\Sigma M = 32.24N \cdot mm + \{-246.19N \cdot mm\}$
$\Sigma M = -213.95\ N \cdot mm$

which translates into a net moment of 213 N•mm (CCW) forcing the Latch CLOSED.

30 G's applied in Negative Longitudinal direction

Taking clockwise as positive, the internal force, F is applied horizontally at the CG and generates a negative moment about the hinge point across the moment arm formed by the radial offset "R".

$\Sigma M = [-(F \times R) - M] + (1G_{Handle} \times R)$
$\Sigma M = [-(7.41N\{0.95N\} \times 12.93mm\{9.4mm\}) - 66.67N \cdot mm\{254.82N \cdot mm\} + (0.24N\{.032N\} \times 12.93mm\{9.4mm\})$
$\Sigma M = -159.36N \cdot mm + \{-263.45N \cdot mm\}$
$\Sigma M = -422.83\ N \cdot mm$

which translates into a net moment of 422 N•mm (CCW) forcing the Latch CLOSED.

PRODUCT VERIFICATION (THEORETICAL)		
SPECIFICATION: FMVSS-201	CUSTOMER P/N: NCT P/N: 7011-ASM	ISSUE DATE: Mar. 22, 2002
CUSTOMER: General Motors Corp. / Johnson Controls Inc.		PAGE 5 of 5

Summation of Forces and Moments Due to Acceleration

Vertical Directions

Values in *( )* relate to Pawl-section
10 G's - An inertial force generated by 10 G on the handle (Handle = 25.2 grams) can be found by:
(Pawl = 3.22 grams)

$F = m \times s$
$F = 25.2gr.(3.22gr.) \times (10\ G \times 9.807\ m/s^2) = 2471.36g{\cdot}m/s^2\ (315.787g{\cdot}m/s^2)$
$F = 2471.36g{\cdot}m/s^2\ (315.787g{\cdot}m/s^2) \times 0.001$
$F = 2.47\ Newtons\ (0.32\ Newtons)$

1 G Negative Vertical Direction of Parts – $247.13g{\cdot}m/s^2(31.579g{\cdot}m/s^2) \times 0.001 = 0.24Newton(0.032N)$

10 G's applied in Positive Vertical direction

Taking clockwise as positive, the internal force, F is applied vertically at the CG and generates a positive moment about the hinge point across the moment arm formed by the radial offset "R".

$\Sigma M = [(F \times R) - M] + (1G_{Handle} \times R)$
$\Sigma M = [(2.47N(0.32N) \times 12.93mm(9.4mm)) - 66.67N{\cdot}mm(254.82N{\cdot}mm) + (0.24N(.032N) \times 12.93mm(9.4mm))$
$\Sigma M = -31.63N{\cdot}mm + (-251.51N{\cdot}mm)$
$\Sigma M = -283.14N{\cdot}mm$

which translates into a net moment of 283 N•mm (CCW) forcing the Latch CLOSED.

10 G's applied in Negative Vertical direction

Taking clockwise as positive, the internal force, F is applied vertically at the CG and generates a negative moment about the hinge point across the moment arm formed by the radial offset "R".

$\Sigma M = [-(F \times R) - M] + (1G_{Handle} \times R)$
$\Sigma M = [-(2.47N(0.32N) \times 12.93mm(9.4mm)) - 66.67N{\cdot}mm(254.82N{\cdot}mm) + (0.24N(.032N) \times 12.93mm(9.4mm))$
$\Sigma M = -95.51N{\cdot}mm + (-257.53N{\cdot}mm)$
$\Sigma M = -353.04N{\cdot}mm$

which translates into a net moment of 353 N•mm (CCW) forcing the Latch CLOSED.

Attachment 2

TWO 04WC0-593-00 – 2004 Pontiac Grand Prix Compliance to FMVSS 201 Lower Latching Requirements

2004 Grand Prix Console Door Latch Calculations

CG190 (Rev. April_2002) GM CONFIDENTIAL Page 1 of

GM Evaluation Report

Platform	Project/EWO No.	Requirement No.	Procedure No.	VPP/VIA/UPC	Model Year	Model No.	PER/Report No.
PONTIAC GRAND		FMVSS 201L	0000	1C 1J	2004	GMX367	04WC0-593-00

Int. Reg. No. FMVSS 201L Category: VPA - Vehicle Product Assurance

Function: ☐ Development ☑ Validation
Method: ☐ Math Based ☑ Hardware Based

Date: 14/Oct/2002 ☑ Final
Title: OCCUPANT PROTECTION-COMPARTMENT DOOR LATCHING ☐ Interim No.
☐ Reissue Date of Reissue:

To (Requestor): N/R Date of Request: 14/Oct/2002
From: ALICIA SOPALA Dates of Evaluation:

Objective: Report generated to document compliance of the 2004 GMX367 Pontiac Grand Prix to FMVSS 201 lower latching requirements.

Conclusions: 2004 GMX367 Pontiac Grand Prix are in compliance with FMVSS 201 lower latching requirement.

Recommendations: None.

Design Evaluated: **GMUTS Rating:** **Veh Mileage:**

Part/Test Object Name(s)	Veh/Buck/PT/PartNo./RPO:	Revision Date/Level

Distribution:

Name: N/A Loc: N/A
Name: Loc:
Name: Loc:
Name: Loc:
Name: Loc:

Cc:

Author: Alicia Sopala Date 16-Oct-2002
(Title/ Phone) Validation Egr. 586-986-4866
(Location) 480-111-W15

Approver: Keith Nelson Date OCT 17, 2002
(Title) Validation EGM 586-986-5735
(Location) 480-111-S28

Approver: Not Required Date N/A
(Title)
(Location)

GM Evaluation Report

Platform	Project/EWO No.	Requirement No.	Procedure No.	VPP/MA/UPC	Model Year	Model No.	PER/Report No.
PONTIAC GRAND		FMVSS 201L	0000	1C 1J	2004	GMX367	04WC0-593-00

Int. Reg. No. FMVSS 201L Category: VPA - Vehicle Product Assurance

Recommendations (Expanded): None.

Foreword: N/A

Requirements:
MVSS Legal Requirement LV.201

Background: N/A

Assumptions/Limitations: N/A

Analysis Model: N/A

Equipment:

None

Procedure/Method:
L2-1A2B-201G

Results:
See attached

Reference Issue Report (PIMREP / PRTS): N/A

References/File Storage: N/A

Calibration Report Information: N/A

Appendix:

The 2004 GMX367 Pontiac Grand Prix Console latch calculations.

2003 GMX367 Floor Console Bin Crash Calculations

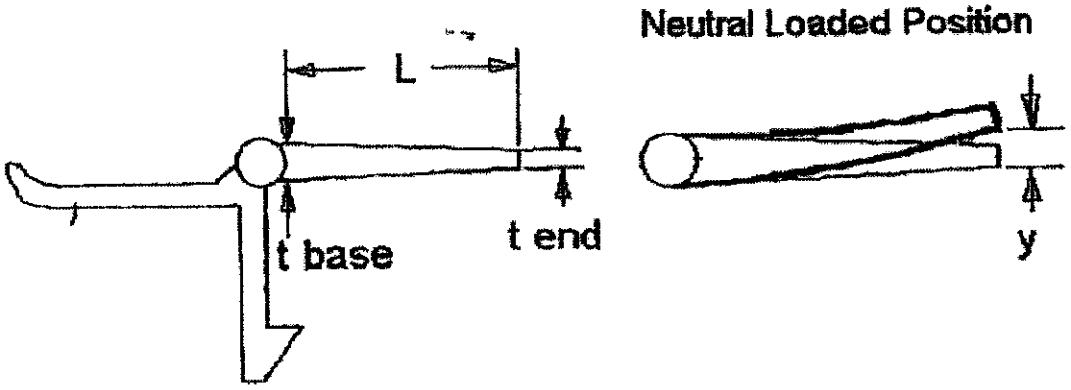
And Latch Stress Analysis

1/23/2001

FOR ALICIA
CAE VALIDATION

FROM
BRIAN
JCI VALIDATION

TAPERED LATCH SPRING



INPUTS:

$y := 2mm$ $L := 40 \cdot mm$ $t_{base} := 2.2 \cdot mm$

$E := 2590 \cdot 10^6 \cdot Pa$ $w := 14.2 \cdot mm$ $t_{end} := 1.3 \cdot mm$

Material is Acetal

CALCULATIONS:

$$t(x) := \left[t_{base} - \frac{(t_{base} - t_{end})}{L} \cdot x \right]$$

$$I(x) := \frac{w \cdot t(x)^3}{12} \qquad A(x) := w \cdot t(x) \qquad c(x) := \frac{t(x)}{2}$$

$$y = \int_{0 \cdot mm}^{L} \frac{F \cdot (L - x)^2}{E \cdot I(x)} dx$$

$$F := \frac{y}{\int_{0 \cdot mm}^{L} \frac{(L - x)^2}{E \cdot I(x)} dx}$$

[redacted]

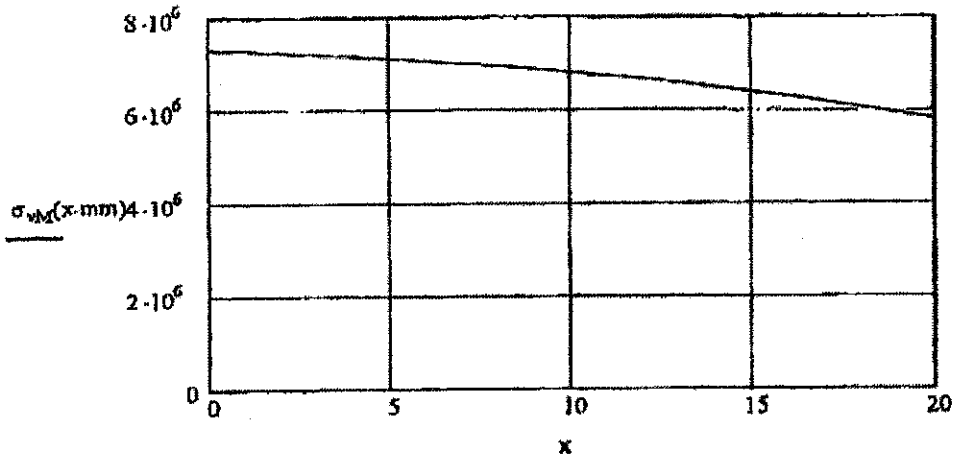
$$M(x) := F \cdot (L - x)$$

The vonMises stress as a function of x is:

$$\sigma_{vM}(x) := \sqrt{\left[\frac{M(x)\cdot(t(x)-c(x))}{I(x)}\right]^2 + 3\cdot\left(\frac{F}{A(x)}\right)^2} \qquad \sigma_{vM}(0\cdot mm) = 7.317\times 10^6\,Pa$$

$$U = \int_0^L \frac{M(x)^2}{2\cdot E\cdot I(x)}\,dx \qquad U = \int_0^L \frac{[F\cdot(x-L)]^2}{2\cdot E\cdot I(x)}\,dx \qquad y_{max} = \frac{d}{dF}U$$

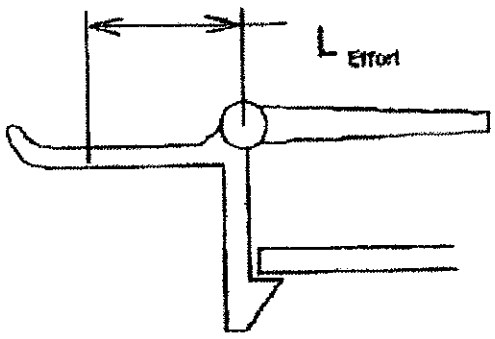
$$y_{max} := \int_{0\cdot mm}^{L} \frac{F\cdot(x-L)^2}{E\cdot I(x)}\,dx$$



If necessary, set upper x limit on graph to value for L.

For questions on this calculation sheet, contact Gary Miller @2936.

Latch Opening Efforts



$L_{effort} := 25mm$

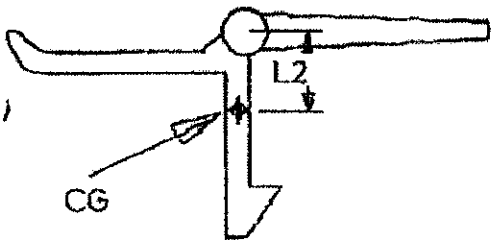
y = deflection of spring at rest

y open = deflection of spring at disengagement

$$Effort_{min} := F \cdot \frac{L}{L_{effort}}$$

Effort$_{min}$ = 3.2 newtons

30 G Frontal Crash Calculation



Input Variables:

$mass_{latch} := .015kg$ $L2 := 8mm$

Moment of latch in forward direction must be less than the moment of the spring force:

$M_{latch} := mass_{latch} \cdot 30g \cdot L2$

$M_{latch} = 0.035\,kg\,m^2\,sec^{-2}$

$M_{spring} := F \cdot L$

$M_{spring} = 0.084\,kg\,m^2\,sec^{-2}$

$Safetyfactor := \frac{M_{spring}}{M_{latch}}$

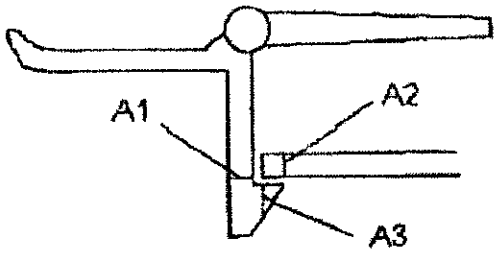
Safetyfactor = 2.4

If Safety Factor is greater than 1 then the system passes 30G forward crash Acceleration

30G Rearward Crash Calculation

This latching system by design increases latching engagement in a rearward crash therefore
It passes 30G rearward crash requirements by inspection.

10 G Vertical Crash Calculation



A. Failure Mode - Latch Shear - Latch tab will shear with a vertical load. Assumes worst case that all the load is concentrated on the latch.

Input variables

$mass_{lid} := 2kg$ $A_1 := 64.6mm^2$ $A_2 := 129.3mm^2$ $Latch_{shear} := 4400psi$

$Latch_{tensile} := 8800psi$ $A_3 := 94.1mm^2$

$F := 10g \cdot (mass_{lid} + mass_{latch})$

$F = 197.604\,kg\,m\,sec^{-2}$

$\tau_{max} := \left(3\frac{F}{2A_3}\right)$

$\tau_{max} = 3.15 \times 10^{6}\,kg\,m^{-1}\,sec^{-2}$

$Safetyfactor := \frac{Latch_{shear}}{\tau_{max}}$

Safetyfactor = 9.661

If the safety factor is greater than 1 the latch will not fail in shear.

B. Failure Mode - Latch Tension - Worst case assume all load is distributed through the latch catch.

$$\sigma_{max} := \left(\frac{F}{A_1}\right)$$

$$\sigma_{max} = 3.059 \times 10^{6}\,kg\,m^{-1}\,sec^{-2}$$

$$Safetyfactor := \frac{Latch_{tensile}}{\sigma_{max}}$$

[redacted]

If the safety factor is greater than 1 the latch will not fail in Tension.

C. Failure Mode - Substrate Catch Shear - Substrate catch will shear with a vertical load. Assumes worst case all the load is concentrated thru the latch.

$$\tau_{max} := \left(3\frac{F}{2A_2}\right) \qquad Catch_{shear} := 3850psi$$

$$\tau_{max} = 2.292 \times 10^{6}\,kg\,m^{-1}\,sec^{-2}$$

$$Safetyfactor := \frac{Catch_{shear}}{\tau_{max}}$$

[redacted]

If the safety factor is greater than 1 the latch catch will not fail in shear.

10 G Downward Vertical Acceleration

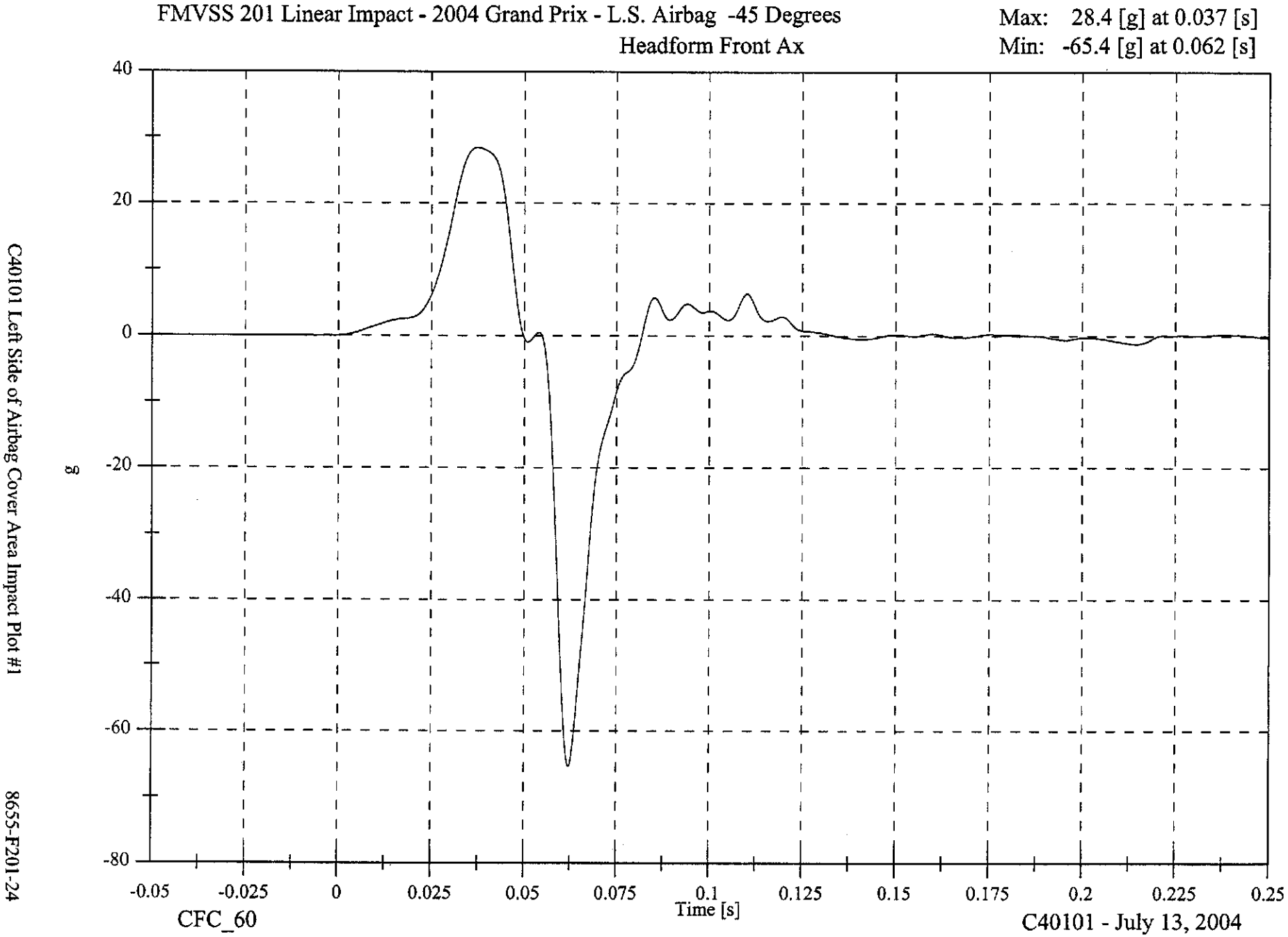
The armrest lid will not open in downward vertical acceleration by inspection.

10 G Upward Acceleration

The center of gravity of the latch is rearward of the pivot, therefore upward acceleration will increase
latching engagement. The armrest lid will not open by inspection.

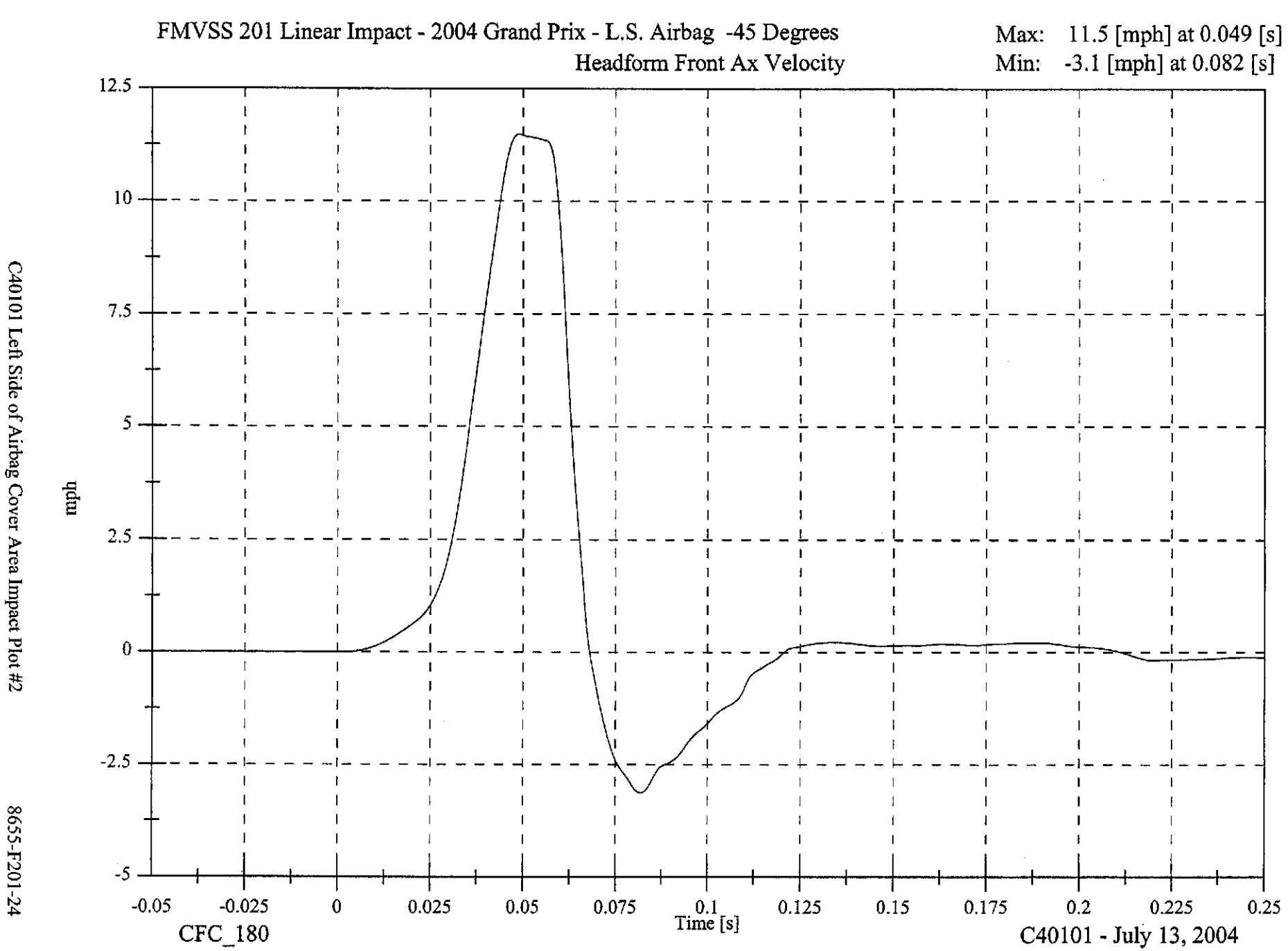
APPENDIX C

DATA PLOTS



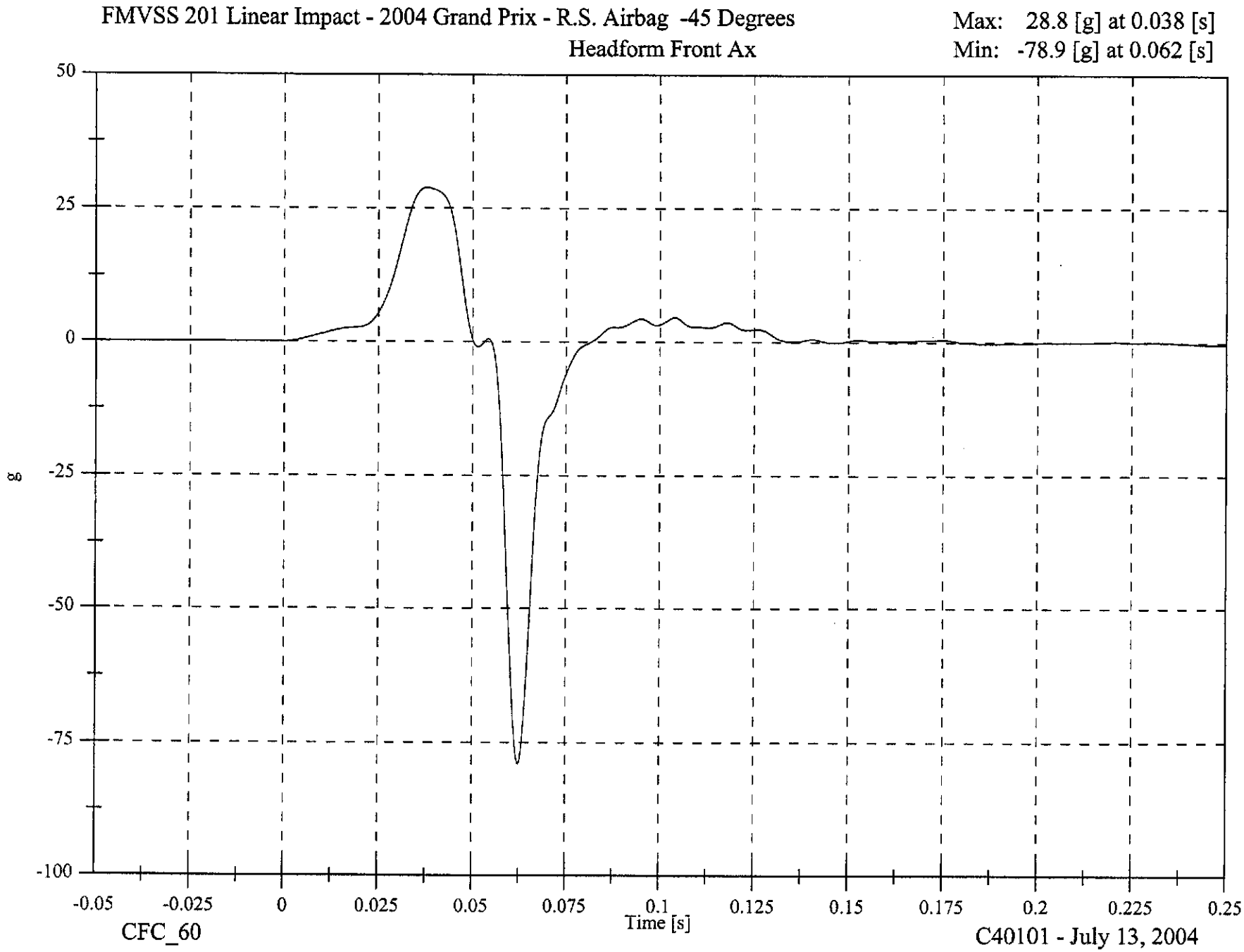
C40101 Left Side of Airbag Cover Area Impact Plot #1

8655-F201-24



C40101 Left Side of Airbag Cover Area Impact Plot #2

8655-F201-24

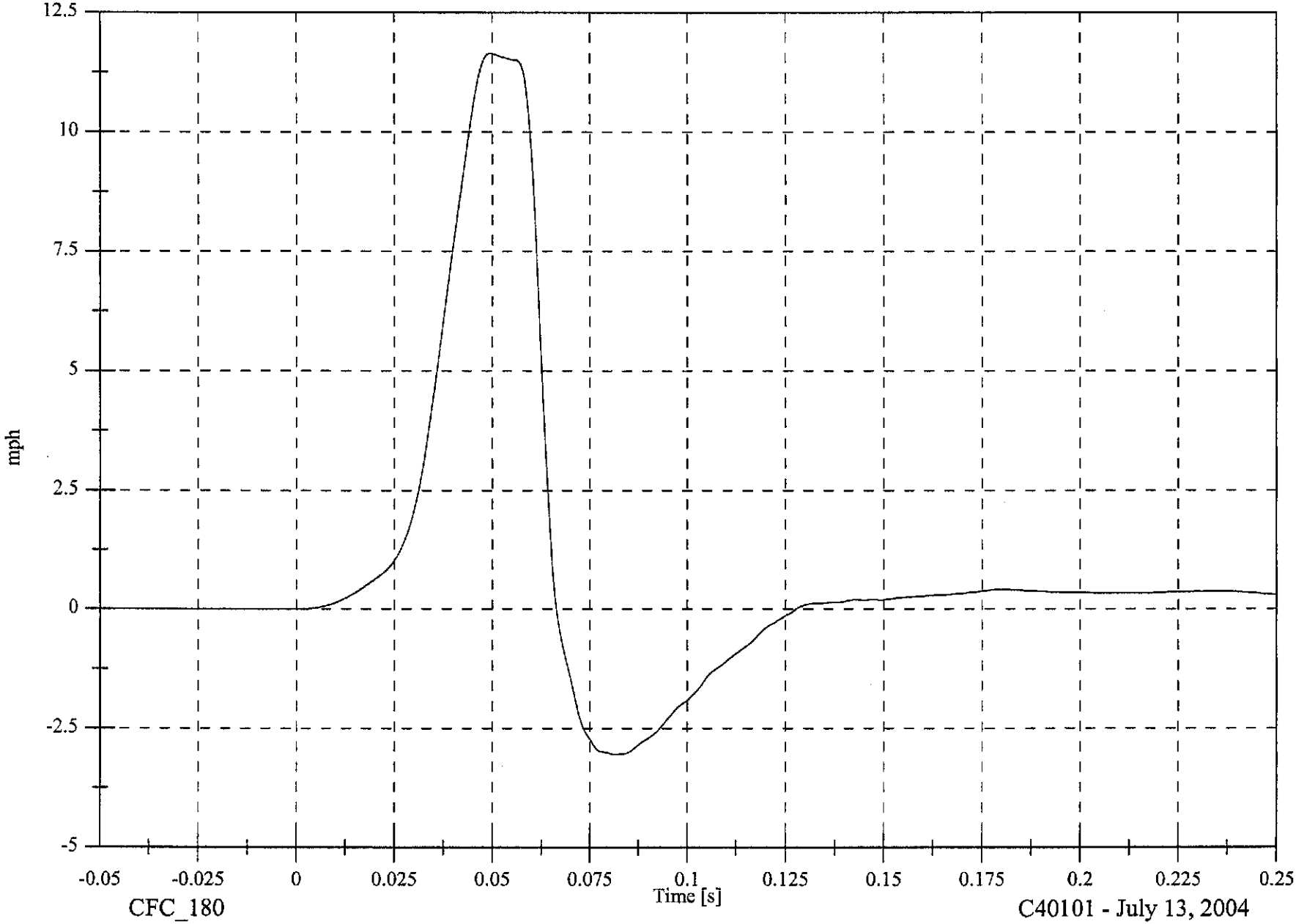


C40101 Right Side of Airbag Cover Impact Plot #1

8655-F201-24

FMVSS 201 Linear Impact - 2004 Grand Prix - R.S. Airbag -45 Degrees
Headform Front Ax Velocity

Max: 11.6 [mph] at 0.049 [s]
Min: -3.0 [mph] at 0.081 [s]

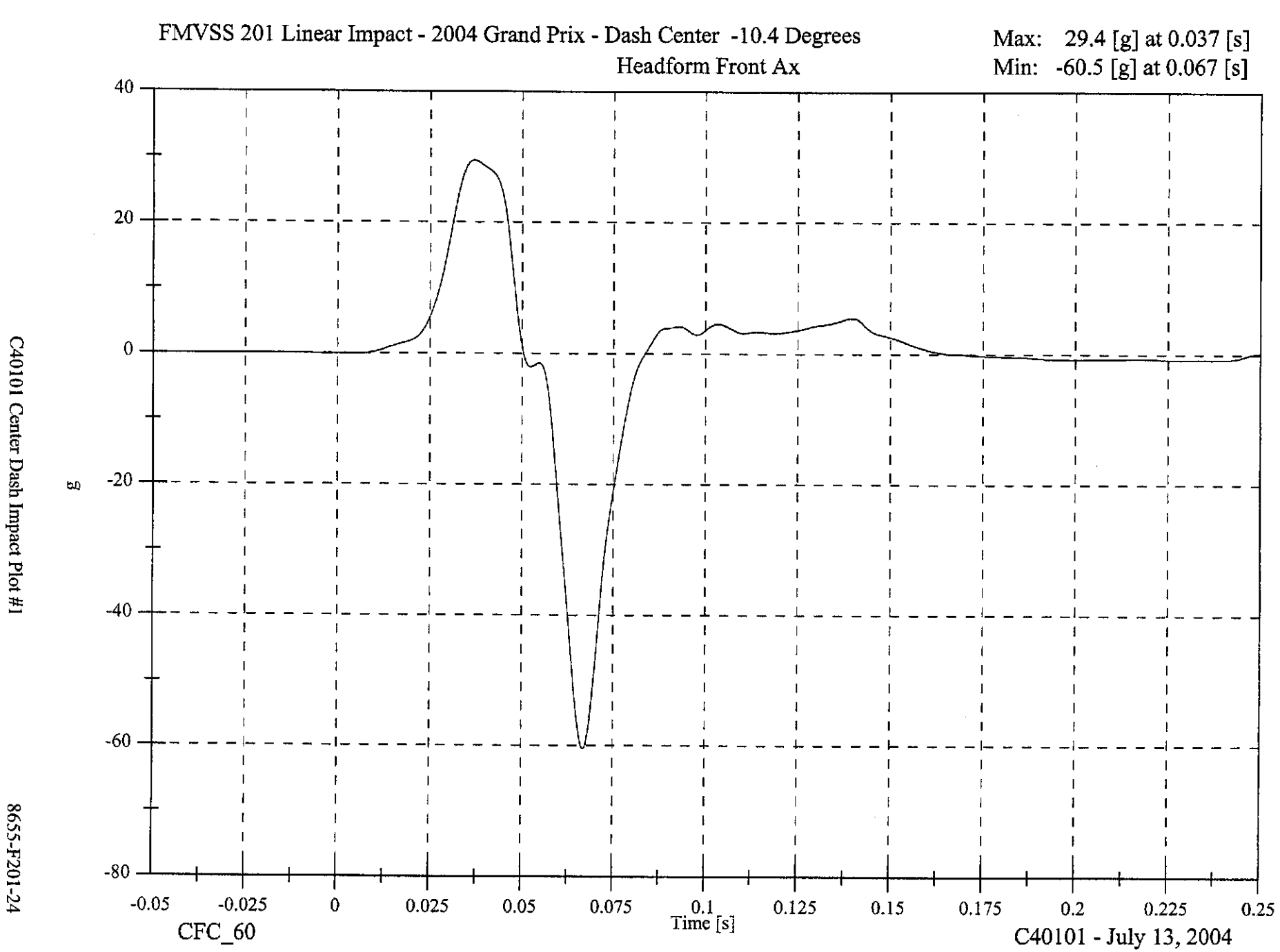


CFC_180

C40101 - July 13, 2004

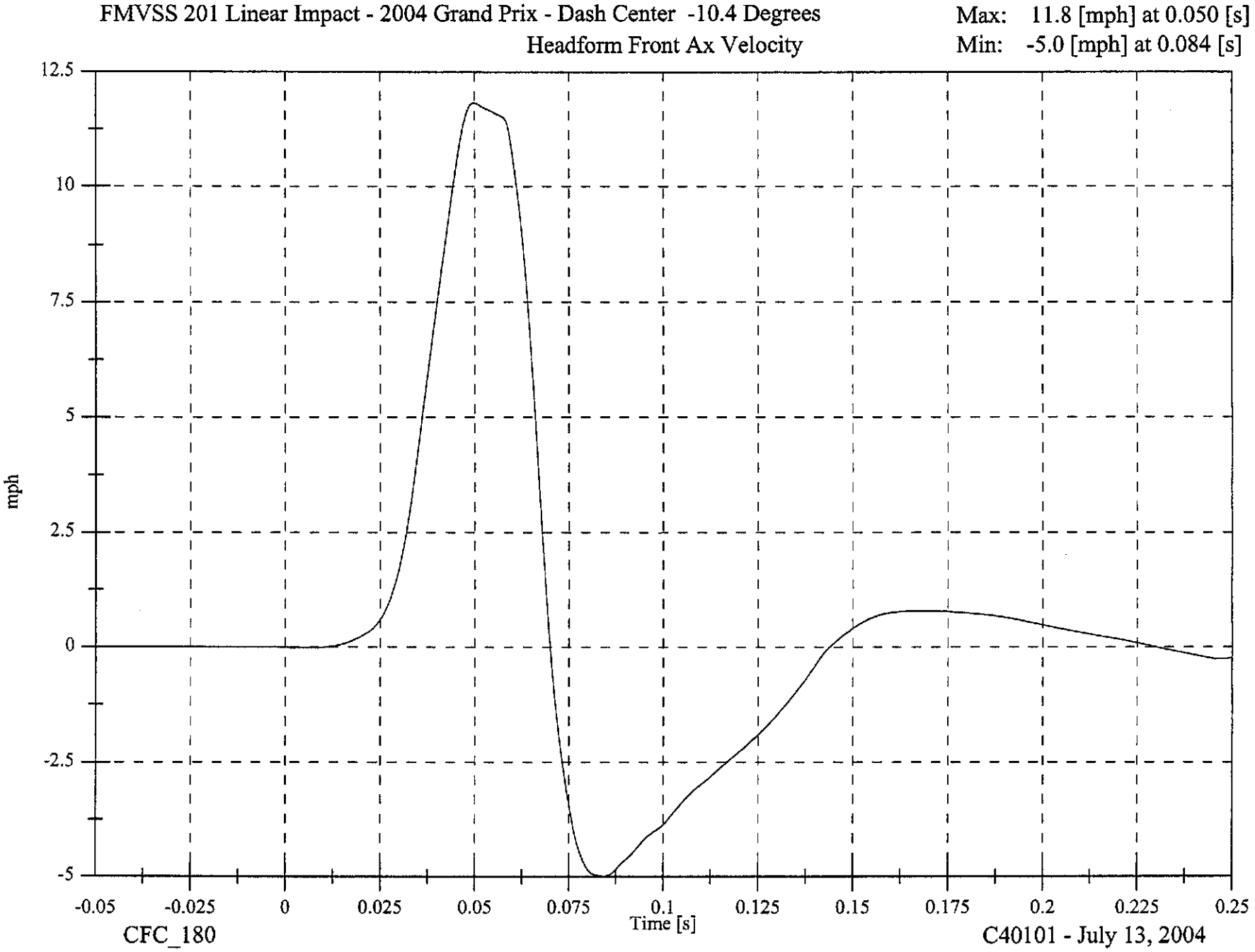
C40101 Right Side of Airbag Cover Impact Plot #2

8655-F201-24



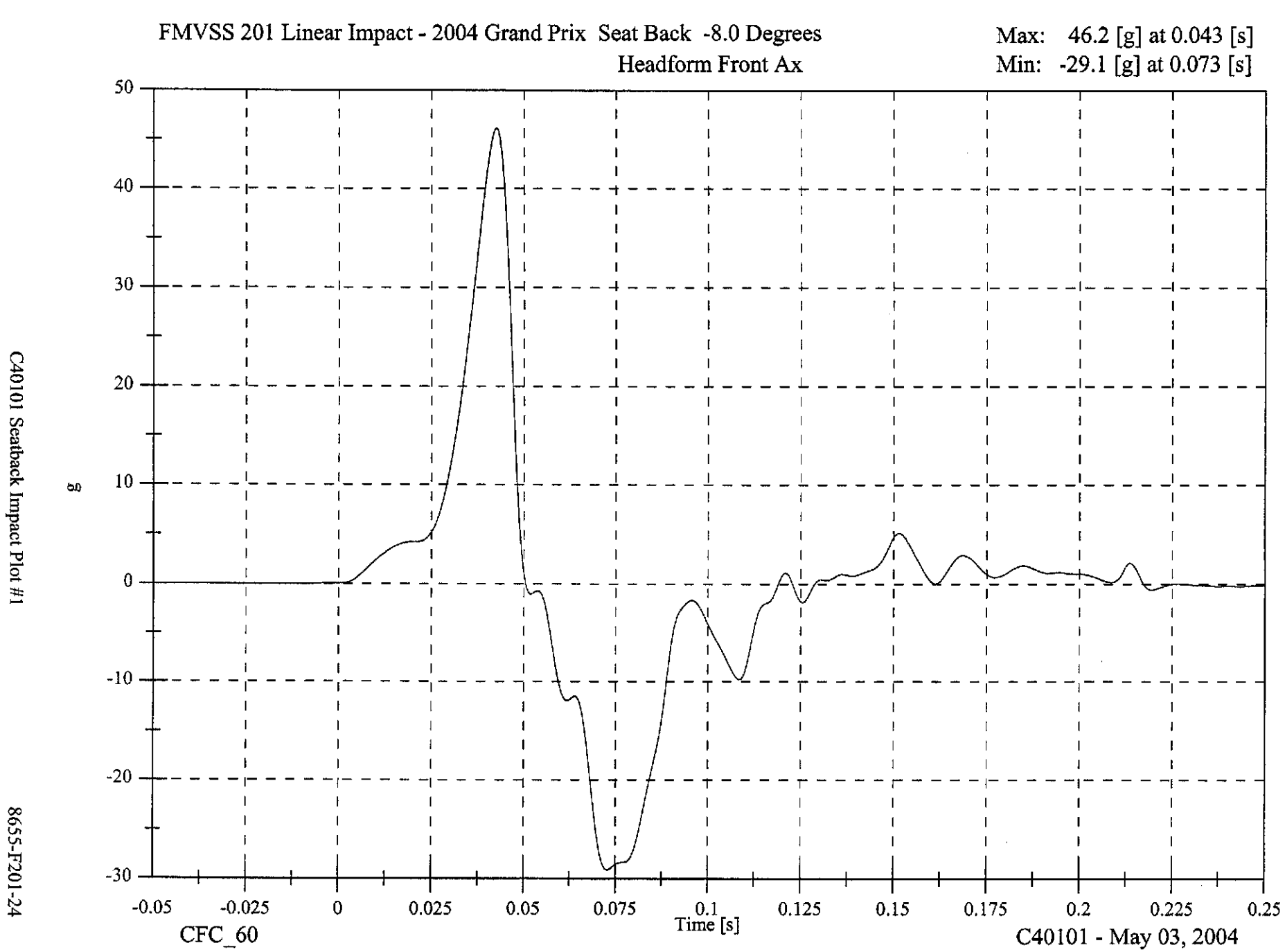
C40101 Center Dash Impact Plot #1

8655-F201-24



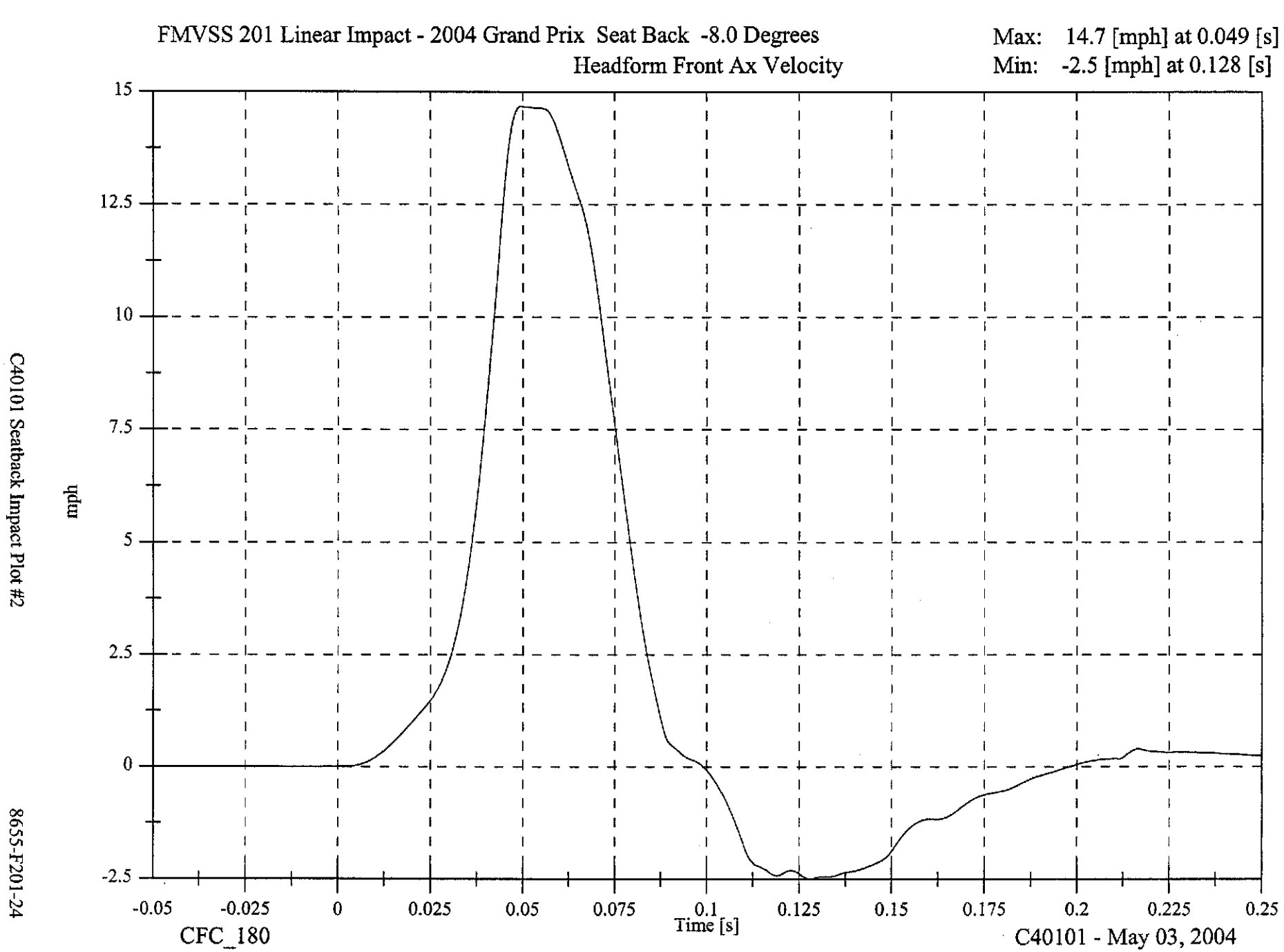
C40101 Center Dash Impact Plot #2

8655-F201-24



C40101 Seatback Impact Plot #1

8655-F201-24


FMVSS 201 Linear Impact - 2004 Grand Prix Seat Back -8.0 Degrees
Headform Front Ax Velocity
Max: 14.7 [mph] at 0.049 [s]
Min: -2.5 [mph] at 0.128 [s]
15
12.5
10
7.5
5
2.5
0
-2.5
mph
-0.05
-0.025
0
0.025
0.05
0.075
0.1
0.125
0.15
0.175
0.2
0.225
0.25
Time [s]
CFC_180
C40101 - May 03, 2004
C40101 Seatback Impact Plot #2
8655-F201-24