REPORT NUMBER 103-GTL-06-001

SAFETY COMPLIANCE TESTING FOR FMVSS NO. 103 WINDSHIELD DEFROSTING AND DEFOGGING SYSTEMS

HYUNDAI MOTOR COMPANY
2006 HYUNDAI SONATA, PASSENGER CAR
NHTSA NO. C60502

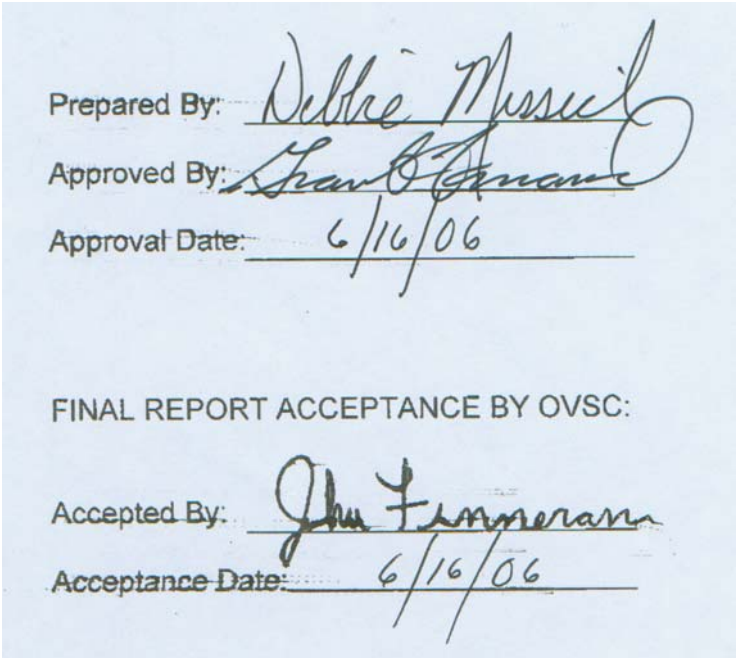
GENERAL TESTING LABORATORIES, INC.
1623 LEEDSTOWN ROAD
COLONIAL BEACH, VIRGINIA 22443

JUNE 16, 2006

FINAL REPORT

PREPARED FOR

U. S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
400 SEVENTH STREET, SW
ROOM 6111 (NVS-220)
WASHINGTON, D.C. 20590



Technical Report Documentation Page

1. Report No. 103-GTL-06-001	2. Government Accession No. N/A	3. Recipient's Catalog No. N/A
4. Title and Subtitle Final Report of FMVSS 103 Compliance Testing of 2006 HYUNDAI SONATA, PASSENGER CAR NHTSA No. C60502		5. Report Date June 16, 2006 6. Performing Organ. Code GTL
7. Author(s) Grant Farrand, Project Engineer Debbie Messick, Project Manager		8. Performing Organ. Rep# GTL-DOT-06-103-001
9. Performing Organization Name and Address General Testing Laboratories, Inc. 1623 Leedstown Road Colonial Beach, Va 22443		10. Work Unit No. (TRAIS) N/A 11. Contract or Grant No. DTNH22-01-C-11025
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Admin. Enforcement Office of Vehicle Safety Compliance (NVS-220) 400 7th Street, S.W., Room 6111 Washington, DC 20590		13. Type of Report and Period Covered Final Test Report May 16-17, 2006 14. Sponsoring Agency Code NVS-220
15. Supplementary Notes		
16. Abstract Compliance tests were conducted on the subject, 2006 Hyundai Sonata Passenger Car in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-103-13 for the determination of FMVSS 103 compliance. Test failures identified were as follows: None		
17. Key Words Compliance Testing Safety Engineering FMVSS 103	18. Distribution Statement Copies of this report are available from NHTSA Technical Information Services (TIS) Room 2336 (NP0-405) 400 7th St., S.W. Washington, DC 20590 Telephone No. (202) 366-4947	
19. Security Classif. (of this report) UNCLASSIFIED	21. No. of Pages 32	22. Price
20. Security Classif. (of this page) UNCLASSIFIED		

Form DOT F 1700.7 (8-72)

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SECTION 1

PURPOSE OF COMPLIANCE TEST

1.0 PURPOSE OF COMPLIANCE TEST

A 2006 Hyundai Sonata Passenger Car was subjected to Federal Motor Vehicle Safety Standard (FMVSS) No. 103 testing to determine if the vehicle was in compliance with the requirements of the standard. All tests were conducted in accordance with NHTSA, Office of Vehicle Safety Compliance (OVSC) Laboratory Procedure, TP-103-13 dated 26 June 1996 and General Testing Laboratories, Inc. (GTL) Test Procedure, "Windshield Defrosting and Defogging Systems – Passenger Vehicles, Mulitpurpose Vehicles, Trucks and Buses".

1.1 TEST VEHICLE

The test vehicle was a 2006 Hyundai Sonata Passenger Car. Nomenclature applicable to the test vehicle are:

A. Vehicle Identification Number: KMHET46C96A162388

B. NHTSA No.: C60502

C. Manufacturer: HYUNDAI MOTOR COMPANY

D. Manufacture Date: OCT/31/05

1.2 TEST DATE

The test vehicle was subjected to FMVSS No. 103 testing on May 16-17, 2006.

SECTION 2

COMPLIANCE TEST PROCEDURE AND SUMMARY OF RESULTS

2.0 GENERAL

The 2006 Hyundai Sonata 4-door passenger car, NHTSA No. C60502 was subjected to FMVSS No. 103 tests on May 16-17, 2006. Photographs of the test vehicle are shown in Figures 5.1 through 5.4. The manufacturer's certification and tire information labels are shown in Figures 5.5 and 5.6. The test instrumentation and instrument panel setups are depicted in Figures 5.7 and 5.8. Figures 5.9 through 5.16 depict the windshield pre and post test defrost conditions.

2.1 TEST PROCEDURE

Prior to test the test vehicle was inspected for completeness, systems operability, and appropriate fuel and liquid levels, i.e., oil and coolant to include antifreeze protection. The vehicle was then photographically documented as required by the DOT/NHTSA test procedure. The windshield patterns for areas A, B and C had been furnished prior to testing and these areas were outlined on the windshield with a marker. The vehicle was then installed in the cold chamber and pre-conditioned for a 14-hour minimum, 0º ±5º F temperature soak for the first test run. After the pre-condition, the hood was raised to assure engine coolant and lubricant were stabilized within the test temperature range for a minimum of 2 hours.

At the end of the 2-hour minimum stabilization period, the entire windshield was sprayed evenly with 0.010 ounces of water per square inch of glass area. Refer to Section 3, Compliance Test Data, for test specifics such as total amount of water sprayed, spray gun identification, and air pressure regulation. The vehicle soak continued for an additional 30 minutes minimum but no more than 40 minutes after the windshield was sprayed.

At the conclusion of the additional soak time the vehicle's engine was started and operated at a target speed of 1500-1600 rpm or at the manufacturer's specification if different as noted on data sheets. The defroster blower was turned on to the high speed setting with the heater selector in the de-ice (defrost) position, and the temperature control in the maximum temperature position. All doors and windows were closed. The heater air intake was fully open and the vehicle's hood closed. At no time during the test were the windshield wipers used.

SECTION 2 continued

At start of testing and during test, at each 5-minute interval after engine start, cold chamber, engine coolant, heater coolant in and defroster air left/defroster air right temperatures were recorded. Likewise at each 5-minute interval the boundary of the defrosted area was marked on the inside surface of the windshield. The test was run for a maximum of 40 minutes from engine start, or until such time as 100 percent windshield clearance was achieved. Photographs were made of the windshield at the pre-test frosted state and 20-minute and 25-minute intervals. Post test actions included placing a vellum pattern on the windshield and tracing the windshield's 5-minute interval defrosted area boundary lines onto the vellum pattern.

After the traces were obtained, the windshield was again thoroughly cleaned and the vehicle engine coolant and lubricant stabilization period at 0º ±5º F temperature commenced for a repeat of the procedure discussed. The windshield patterns for both tests were used subsequently to determine the cleared area percentages.

2.2 SUMMARY OF RESULTS

Based on the test performed, the test vehicle appears to be in compliance with the requirements of FMVSS 103.

SECTION 3

COMPLIANCE TEST DATA

3.0 TEST RESULTS

The following data sheets document the results of testing on the 2006 Hyundai Sonata.

SUMMARY DATA SHEET
FMVSS 103, WINDSHIELD DEFROSTING AND DEFOGGING SYSTEMS

VEH. MOD YR/MAKE/MODEL/BODY: 2006 HYUNDAI SONATA PASSENGER CAR
VEH. NHTSA NO: C60502; VIN: KMHET46C96A162388
VEH. BUILD DATE: OCT/31/05 TEST DATE: MAY 16-17, 2006
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE

WINDSHIELD AREA: 1954 in^2 AREA C = 263.1 in^2 AREA D = 263.1 in^2 AREA A= 1141.7 in^2

MANUFACTURER'S WINDSHIELD PATTERN USED: Yes X No

ENGINE THERMOSTAT NOMINAL REGULATING TEMPERATURE: 180 ºF

HEATER-DEFROSTER SYSTEM INCLUDES AIR CONDITIONER: YES X NO

DESCRIBE UNUSUAL FEATURES OF DEFROSTING SYSTEM: NONE

DESCRIBE UNUSUAL FEATURES OF TEST CAR: NONE

DESIGNATION	AREA PERCENT DEFROSTED					
	TEST 1	TEST 2	AVG	REQ'D	PASS	FAIL
CRITICAL AREA C AT 20 MINUTES	99.7%	99.6%	99.65%	80% MINIMUM	PASS	
PASSENGER AREA D AT 25 MINUTES	100%	100%	100%	80% MINIMUM	PASS	
TOTAL AREA A AT 40 MINUTES	100%	100%	100%	95% MINIMUM	PASS	

REMARKS:

RECORDED BY: G. FARRAND DATE: 05/17/06

APPROVED BY: D. MESSICK

FMVSS 103 TEST DATA RECORD – TEST RUN NO. 1

VEH. MOD YR/MAKE/MODEL/BODY: 2006 HYUNDAI SONATA PASSENGER CAR
VEH. NHTSA NO: C60502; VIN: KMHET46C96A162388
VEH. BUILD DATE: OCT/31/05; TEST DATE: MAY 16-17, 2006
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE

If 1st Test Run, chamber conditioned 14 hours @ 0º ±5º F (14 hrs. min.)

Cold Soak Period: 14 HOURS

Time engine coolant and lubricant remained stabilized at 0º F: 8 hrs. 30 minutes

Water Spray Gun and Nozzle Type: BINKS #66

Spray Gun Pressure: 50 psi (50 psi ± 3 psi)

Water used: 19.6 fluid oz. (0.010 ounces per square inch of windshield area)

Soak Period Between Ice Application and Test Start: 35 minutes (30 to 40 minutes)

Engine Speed: * (Target engine speed 1500 to 1600 rpm)
*MANUFACTURER RECOMMENDED 2000 RPM FOR 1ST 5 MINUTES THEN 1500 RPM

Wind at specified location in front of windshield: .6 mph (0 to 2 mph)

Number of Vehicle Occupants: 1 (2 maximum)

Describe window openings, if any: NONE

TIME FROM START (minutes)	MOTOR VOLTAGE (volts)	TEMPERATURE, ºF					DEFROSTED AREA, %		
		TEST ROOM	ENGINE WATER	HEATER WATER IN	DEFROSTER AIR				
					DRVR	PSGR	A	C	D
0	13.4	-5.0	-5.0	-5.0	-5.0	-5.0	0%	0%	0%
5	14.6	-2.8	10.4	98.4	60.1	59.0	0%	0%	0%
10	14.5	-5.0	38.5	119.7	78.5	76.9	36.2%	26.5%	28.3%
15	14.4	-3.6	66.9	136.6	94.5	92.4	73.2%	82.9%	91.3%
20	14.4	-3.2	76.9	144.8	102.1	99.7	98.5%	99.7%	100%
25	14.4	-1.6	93.8	152.3	109.6	107.0	100%	100%	100%

REMARKS:

RECORDED BY: G. FARRAND DATE: 05/16/06

APPROVED BY: D. MESSICK

FMVSS 103 TEST DATA RECORD – TEST RUN NO. 2

VEH. MOD YR/MAKE/MODEL/BODY: 2006 HYUNDAI SONATA PASSENGER CAR
VEH. NHTSA NO: C60502; VIN: KMHET46C96A162388
VEH. BUILD DATE: OCT/31/05; TEST DATE: MAY 16-17, 2006
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE

If 1st Test Run, chamber conditioned N/A hours @ 0º ±5º F (14 hrs. min.)

Cold Soak Period: 20 HOURS

Time engine coolant and lubricant remained stabilized at 0º F: 17 hrs. ____ minutes

Water Spray Gun and Nozzle Type: BINKS #66

Spray Gun Pressure: 50 psi (50 psi ± 3 psi)

Water used: 19.6 fluid oz. (0.010 ounces per square inch of windshield area)

Soak Period Between Ice Application and Test Start: 35 minutes (30 to 40 minutes)

Engine Speed: * (Target engine speed 1500 to 1600 rpm)
*MANUFACTURER RECOMMENDED 2000 RPM FOR 1ST 5 MINUTES THEN 1500 RPM

Wind at specified location in front of windshield: .5 mph (0 to 2 mph)

Number of Vehicle Occupants: 1 (2 maximum)

Describe window openings, if any: NONE

TIME FROM START (minutes)	MOTOR VOLTAGE (volts)	TEMPERATURE, ºF					DEFROSTED AREA, %		
		TEST ROOM	ENGINE WATER	HEATER WATER IN	DEFROSTER AIR DRVR	DEFROSTER AIR PSGR	A	C	D
0	13.3	-5.0	-5.0	-5.0	-4.0	-4.0	0%	0%	0%
5	14.5	-4.0	8.8	103.7	64.4	64.9	0%	0%	0%
10	14.5	-4.0	30.2	125.1	83.7	82.1	38.1%	27.5%	33.4%
15	14.4	-4.0	61.7	136.2	94.0	92.6	70.7%	82.4%	91.1%
20	14.4	-4.0	75.7	143.6	101.1	98.8	98.4%	99.6%	100%
25	14.4	-1.0	94.1	153.5	110.9	108.2	100%	100%	100%

REMARKS:

RECORDED BY: G. FARRAND DATE: 05/17/06

APPROVED BY: D. MESSICK

SECTION 4
INSTRUMENTATION AND EQUIPMENT LIST

TABLE 1 - INSTRUMENTATION & EQUIPMENT LIST

EQUIPMENT	DESCRIPTION	MODEL/ SERIAL NO.	CAL. DATE	NEXT CAL. DATE
TIMER	ACCU-SPLIT	ACT2	04/06	04/07
TEMPERATURE READOUT	OMEGA	43P	04/06	04/07
TEMPERATURE RECORDER	OMEGA	CT91	04/06	04/07
SPRAY GUN	BINKS	6655	BEFORE USE	BEFORE USE
AIR VELOCITY METER	OMEGA	HHF-616	04/06	04/07
AIR PRESSURE GAGE	BINKS	0-160	05/06	05/07
SCALE	METTLER	200A4M	05/06	05/07
TACHOMETER	MONARCH	ACT-3	04/06	04/07
GRADUATED BEAKER	PHOTAX	N/A	N/A	N/A
EVENT RECORDER	COMPUTER	GEO1	BEFORE USE	BEFORE USE
DATA LOGGER	FLUKE	7471026	12/05	12/06

SECTION 5

PHOTOGRAPHS

2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 103

FIGURE 5.1
LEFT SIDE VIEW OF VEHICLE

2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 103

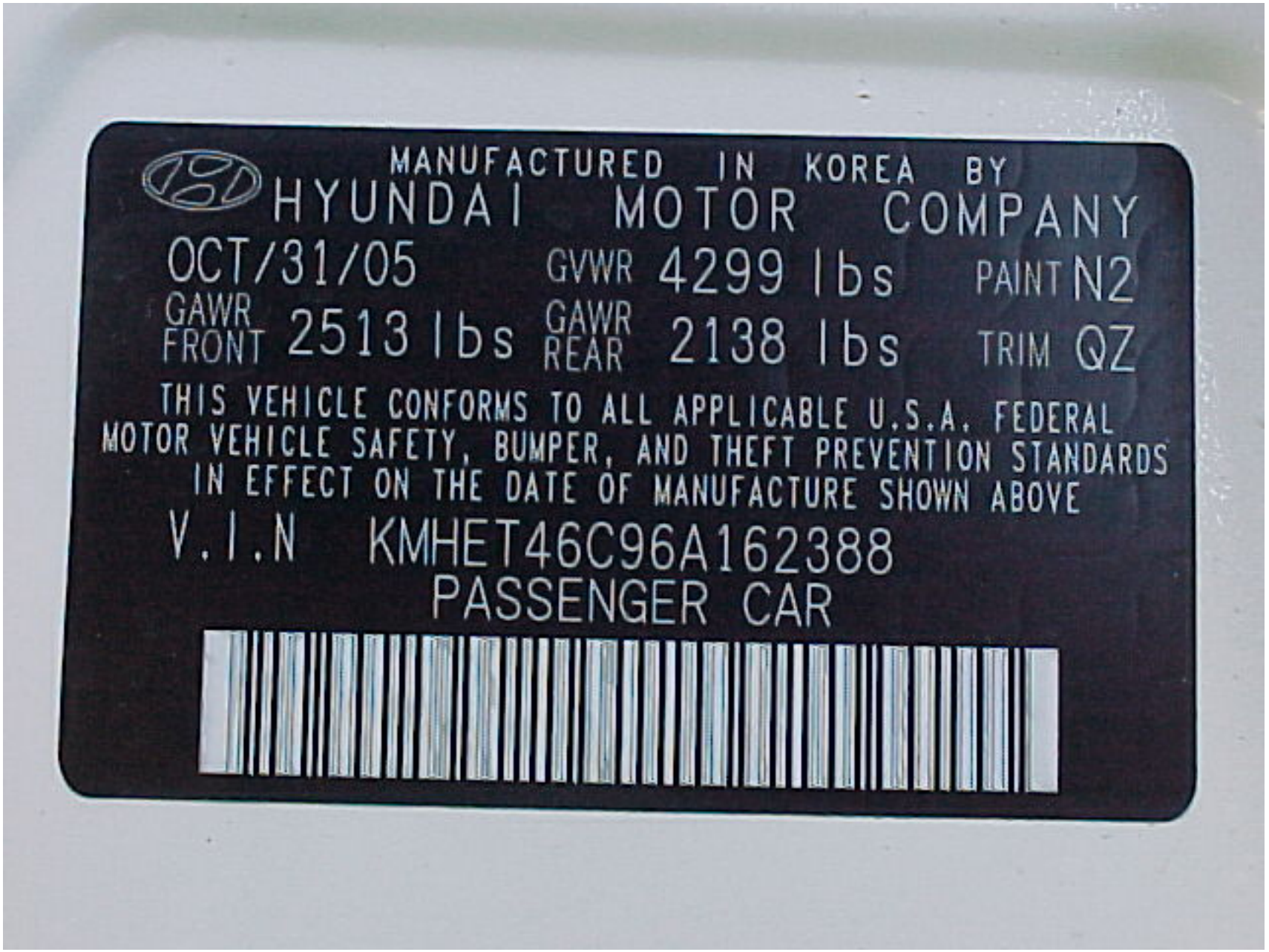
FIGURE 5.2
RIGHT SIDE VIEW OF VEHICLE

2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 103

FIGURE 5.3
¾ FRONTAL VIEW FROM LEFT SIDE OF VEHICLE

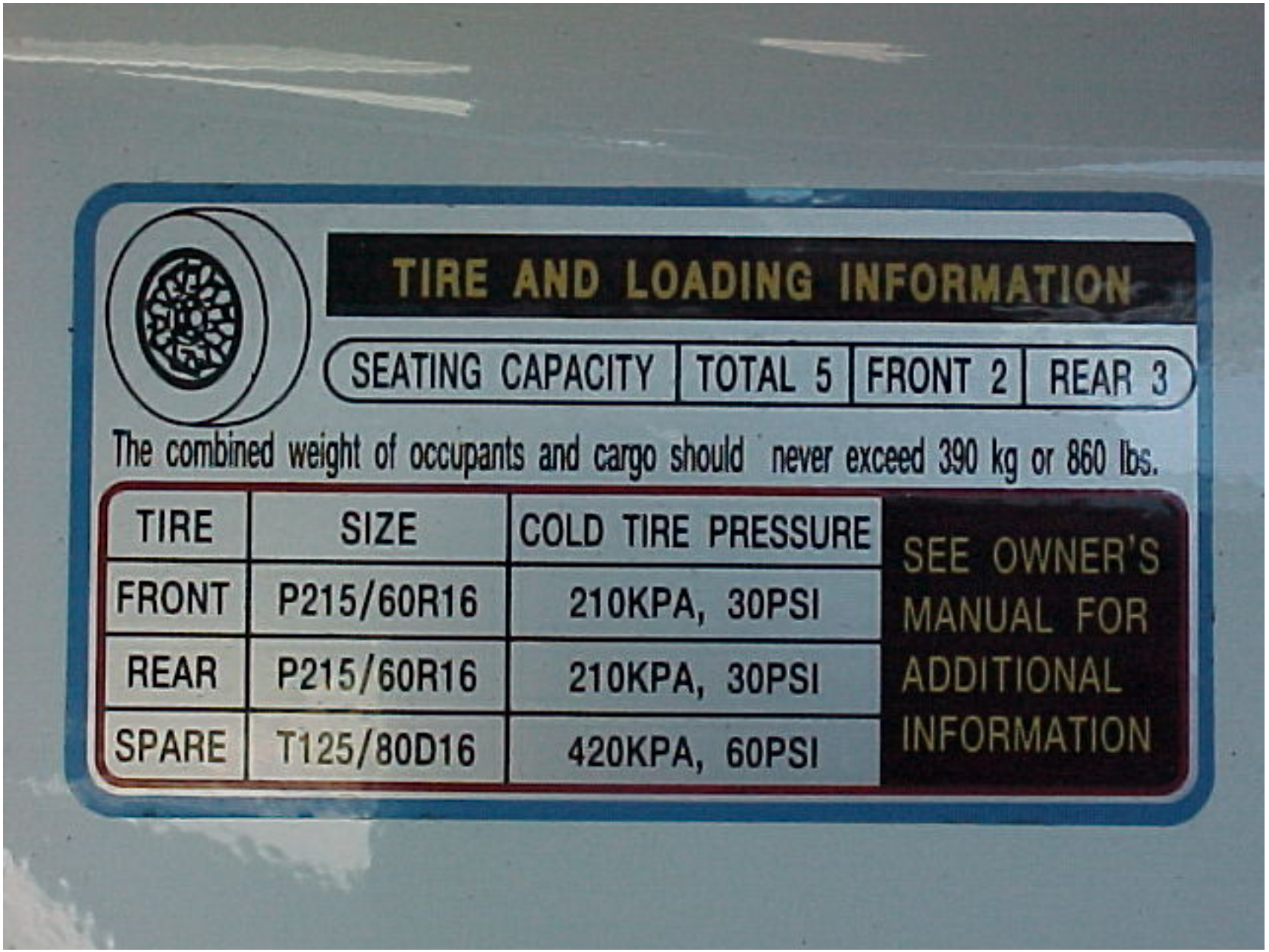
2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 103

FIGURE 5.4
¾ REAR VIEW FROM RIGHT SIDE OF VEHICLE



2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 103

FIGURE 5.5
VEHICLE CERTIFICATION LABEL

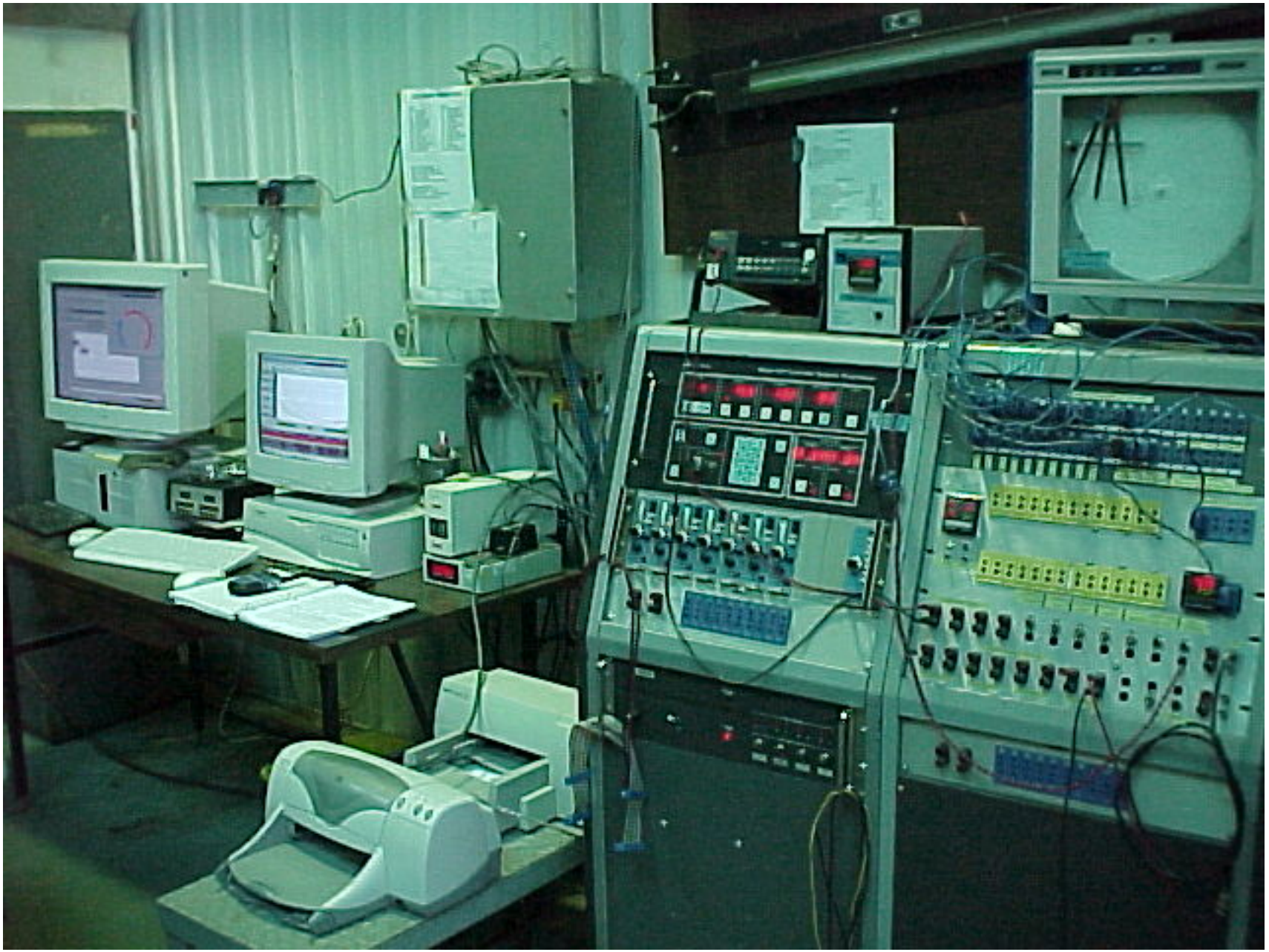


2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 103

FIGURE 5.6
VEHICLE TIRE INFORMATION LABEL

2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 103

FIGURE 5.7
CLOSE-UP VIEW OF DEFROSTER CONTROL
SETTING ON DASH



2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 103

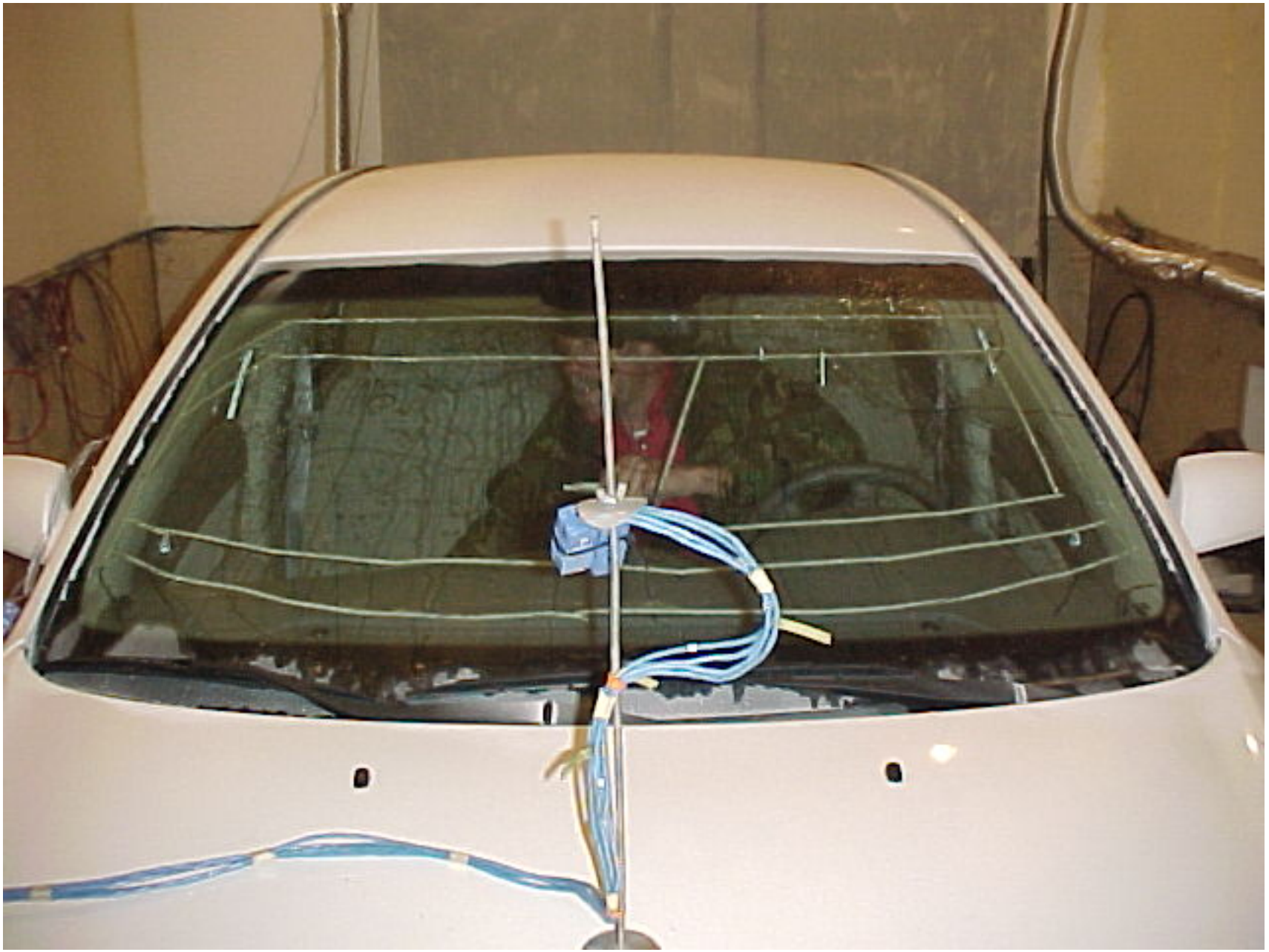
FIGURE 5.8
INSTRUMENTATION SET-UP

2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 103

FIGURE 5.9
WINDSHIELD, PRE-TEST FROSTED STATE
TEST #1

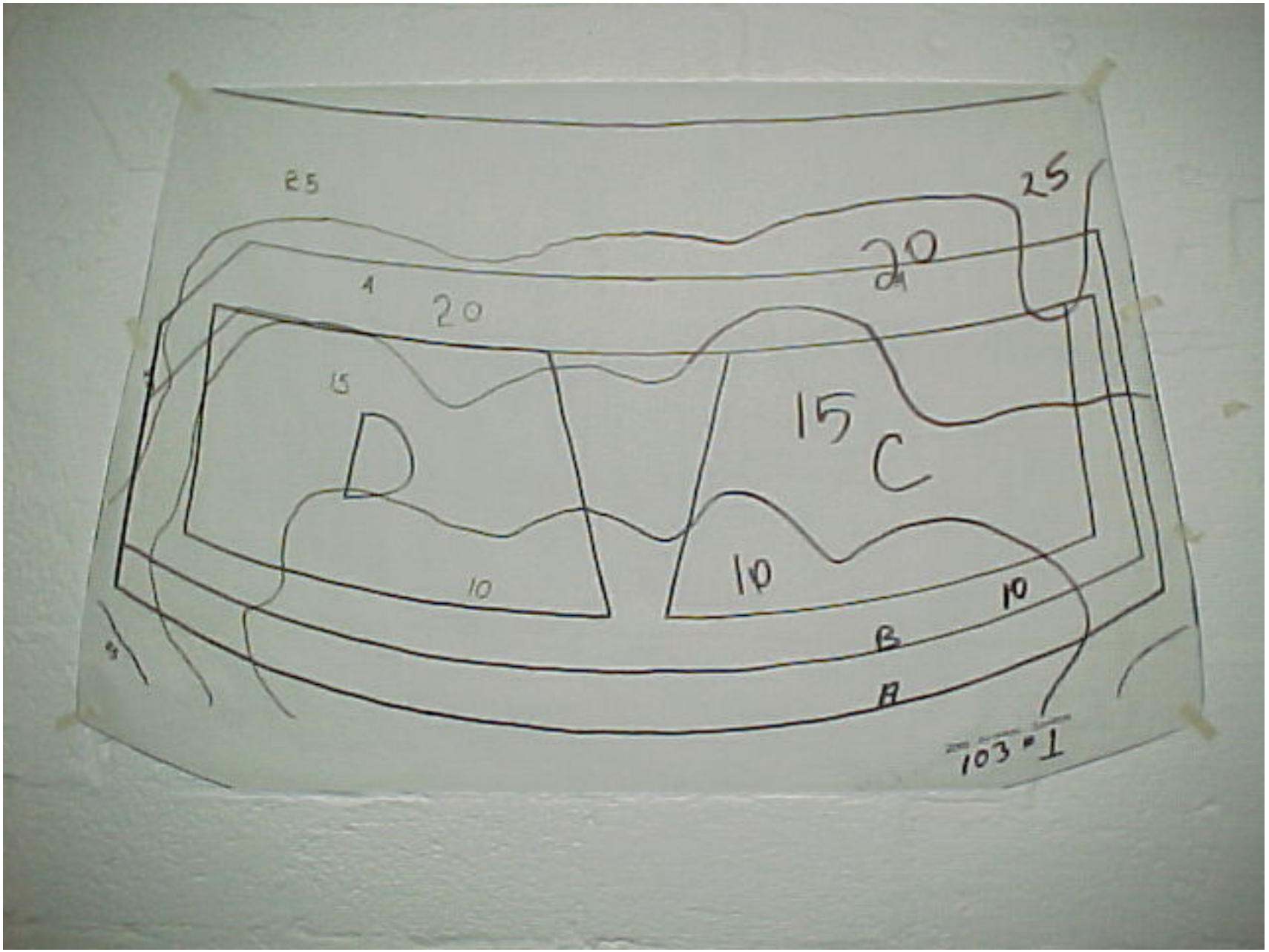
2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 103

FIGURE 5.10
DEFROSTED AREA AT 20 MINUTES TEST #1



2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 103

FIGURE 5.11
DEFROSTED AREA AT 25 MINUTES TEST #1



2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 103

FIGURE 5.12
WINDSHIELD VELLUM PATTERN, POST TEST #1

2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 103

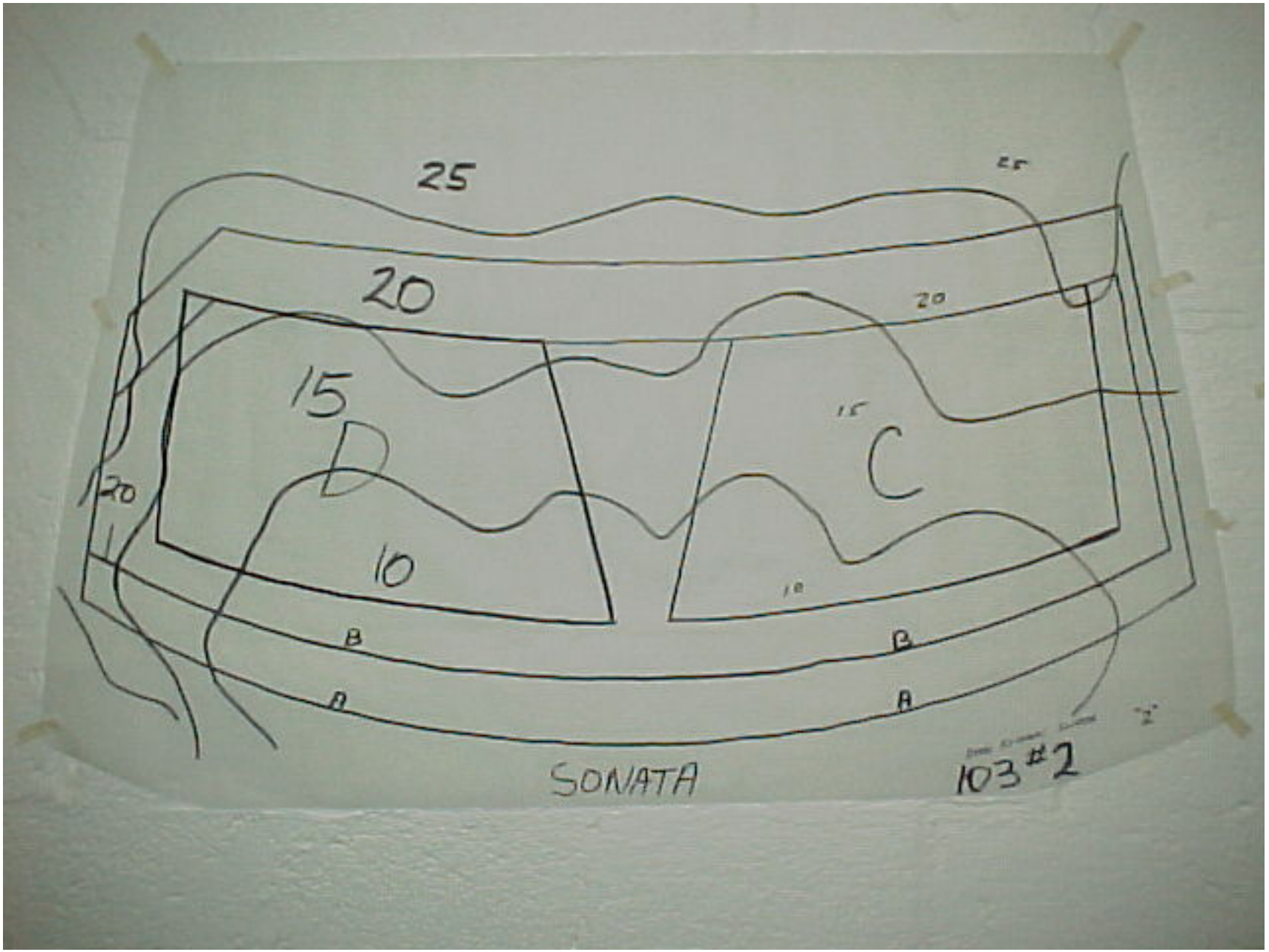
FIGURE 5.13
WINDSHIELD, PRE-TEST FROSTED STATE
TEST #2

2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 103

FIGURE 5.14
DEFROSTED AREA AT 20 MINUTES TEST #2

2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 103

FIGURE 5.15
DEFROSTED AREA AT 25 MINUTES TEST #2



2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 103

FIGURE 5.16
WINDSHIELD VELLUM PATTERN, POST TEST #2

SECTION 6

OWNER'S MANUAL DEFROSTER INSTRUCTIONS

DEFROSTING/DEFOGGING

B720A02E-AAT

Manual A/C

Automatic A/C

B720A01NF-A

Manual A/C

Automatic A/C

B720A02NF-A

Use the heating/ventilation system to defrost or defog the windshield:

To remove interior fog on the windshield;

- o Set the air flow control to the defrost ( ) position. (The A/C will turn on automatically and the "Fresh" mode will be activated.)
- o Set the temperature control to the desired position.
- o Set the fan speed control between "1" and "4" position.

To remove frost or exterior fog on the windshield;

- o Set the air flow control to the defrost ( ) position. (The A/C will turn on automatically and the "Fresh" mode will be activated.)
- o Set the temperature control to warm.
- o Set the fan speed control to position "3" or "4".

NOTE:

When the A/C is operated continuously on the floor-defrost level ( ) or defrost level ( ), it may cause fog to form on the exterior windshield. If this occurs, set the air flow control to the face level position ( ) and fan speed control to the low position.

B970A01Y-AAT

(If Installed)

Your Hyundai is equipped with an automatic heating and cooling control system controlled by simply setting the desired temperature.

B970B01NF-GAT

Heating and Cooling Controls

1. Temperature Control
2. Defroster Switch
3. Display Window
4. Rear Window Defroster Switch
5. Blower Fan Control
6. AUTO (Automatic Control) Switch
7. Air Flow Control Switch
8. Air Conditioning Switch
9. Air Intake Control Switch
10. Air Quality System Switch (If Installed)
11. OFF Switch

TYPE A (Without Air Quality System)

B970B01NF

TYPE B (With Air Quality System)

B970B02NF