REPORT NUMBER 104-GTL-07-005

SAFETY COMPLIANCE TESTING FOR FMVSS NO. 104 WINDSHIELD WIPING AND WASHING SYSTEMS

HYUNDAI MOTOR COMPANY
2007 HYUNDAI ELANTRA, PASSENGER CAR
NHTSA NO. C70502

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

JANUARY 9, 2008

FINAL REPORT

PREPARED FOR

U. S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
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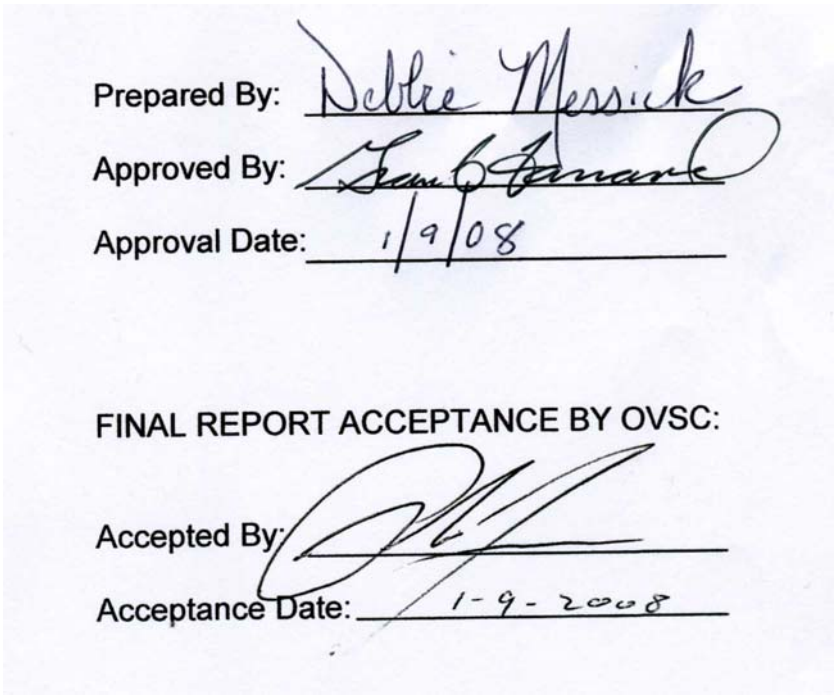

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4. Title and Subtitle Final Report of FMVSS 104 Compliance Testing of 2007 HYUNDAI ELANTRA, PASSENGER CAR NHTSA No. C70502		5. Report Date January 9, 2008 6. Performing Organ. Code GTL
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15. Supplementary Notes		
16. Abstract Compliance tests were conducted on the subject 2007 Hyundai Elantra Passenger Car in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-104-08 for the determination of FMVSS 104 compliance. Test failures identified were as follows: NONE		
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SECTION 1

PURPOSE OF COMPLIANCE TEST

1.0 PURPOSE OF COMPLIANCE TEST

A 2007 Hyundai Elantra Passenger Car was subjected to Federal Motor Vehicle Safety Standard (FMVSS) No. 104 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-104-08 dated 26 June 1996 and General Testing Laboratories, Inc. (GTL) Test Procedure, TP-104-08A dated 4 April 1997.

1.1 The test vehicle was a 2007 HYUNDAI ELANTRA PASSENGER CAR. Nomenclature applicable to the test vehicle are:

A. Vehicle Identification Number: KMHDU46D97U035111

B. NHTSA No.: C70502

C. Manufacturer: HYUNDAI MOTOR COMPANY

D. Manufacture Date: SEP/13/06

1.2 TEST DATE

The test vehicle was subjected to FMVSS No. 104 testing on October 10, 2007.

SECTION 2

COMPLIANCE TEST PROCEDURE AND SUMMARY OF RESULTS

2.0 GENERAL

The 2007 Hyundai Elantra passenger car, NHTSA No. C70502 was subjected to FMVSS No. 104 tests on October 10, 2007. The selected portions of FMVSS No. 104 tests used were as amplified in the following subparagraphs. The test vehicle was positioned in the test system with three water spray nozzles suspended in line with the center of the longitudinal axis of the windshield and horizontal left/right center of the windshield to provide an even distribution of spray to the entire windshield. The height of the nozzles was approximately 22 inches above the glazing surface.

2.1 WIPER FREQUENCY TEST

The wiper frequency test was performed with the engine operating and with a minimum of 50 cubic inches per minute of water from the spray nozzles. The wiper frequency was measured at the low and high wiper speed settings with the engine operating at idle RPM and 2,000 RPM.

2.2 WIPED AREA TEST

The test was conducted with the windshield wiper system operating at the high speed setting, engine at idle RPM and the spray nozzles spraying water at a minimum of 50 cubic inches per minute. The wiper blade wipe pattern was outlined on the glazing surface and then transferred to a windshield pattern. The wiped area was determined for areas A, B and C from the windshield pattern.

2.3 CAPABILITY TEST

The windshield glazing surface was coated with a mixture of water and fine grade test dust. Within 15 seconds following application of the water-dust mixture, the windshield wiper and washing system was activated in the high speed mode for ten complete cycles. The vehicle's engine was operating at idle RPM. The cleared areas of the windshield were marked on the inside windshield surface. After ten complete cycles the system was deactivated and the wiped area transferred to a windshield pattern.

The glazing surface was cleaned and dried. The water dust mixture was re-applied and the test repeated.

The windshield patterns were used subsequently to determine the cleared area percentages.

2.4 SUMMARY OF RESULTS

Based on the test performed, the test vehicle's windshield wiping and washing system appears to meet the requirements of FMVSS 104.

SECTION 3

COMPLIANCE TEST DATA

3.0 TEST RESULTS

The following data sheets document the results of testing on the 2007 Hyundai Elantra.

SUMMARY OF DATA
FMVSS 104, WINDSHIELD WIPING AND WASHING SYSTEMS

VEH. MOD YR/MAKE/MODEL/BODY: 2007 HYUNDAI ELANTRA PASSENGER CAR
VEH. NHTSA NO: C70502; VIN: KMHDU46D97U035111
VEH. BUILD DATE: SEP/13/06 TEST DATE: OCTOBER 10, 2007
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE

WIPER TYPE: 2 SPEED ELECTRIC WITH DELAY

WASHER TYPE: HIGH PRESSURE ELECTRIC

WINDSHIELD AREAS: A = 1057.5 in^2 B = 750.4 in^2 C = 250.4 in^2

MANUFACTURER'S WINDSHIELD PATTERN USED: Yes X No

ACCESSIBILITY:

(1) Washer Control Accessible: Yes X No
(2) Wiper Control Accessible: Yes X No
(3) Washer Reservoir Filler Accessible: Yes X No

DESCRIBE UNUSUAL FEATURES OF WIPING AND WASHING SYSTEMS:

PERFORMANCE:

TEST	PASS	FAIL
WIPER FREQUENCY	X	
WIPED AREA	X	
WASHER CAPABILITY	X	

RECORDED BY: G. FARRAND DATE: 10/11/07

APPROVED BY: D. MESSICK

FREQUENCY TEST DATA
FMVSS 104 – WINDSHIELD WIPER SYSTEM

VEH. MOD YR/MAKE/MODEL/BODY: 2007 HYUNDAI ELANTRA PASSENGER CAR
VEH. NHTSA NO: C70502; VIN: KMHDU46D97U035111
VEH. BUILD DATE: SEP/13/06 TEST DATE: OCTOBER 10, 2007
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE

Water Hardness: 7.0 grains/gallon (12 max.); Date Certified: 09/07

Water Spray Flow Rate: 71.0. in^3/min. (specified range = 50 to 100 in^3/min.)

Ambient Air Temp.: 80 ºF (50-100ºF); Water Temp.: 78 ºF (100ºF max.)

Manufacturer's Recommended Engine Idle Speed: 660 rpm

RUN 1, MAXIMUM WIPER FREQUENCY TEST:

TIME	ENGINE SPEED	TOTAL CYCLES	AVG. CYCLES/MIN. (45 MINIMUM)
1ST 3 minutes	660 (idle ± 50 rpm)	202	67.3
2nd 3 minutes	2000 (2000 rpm ± 50 rpm)	204	68

Frequency at least 45 cycles/minute regardless of engine speed: Yes X No ___

RUN 2, LOWER WIPER FREQUENCY TEST:

TIME	ENGINE SPEED	TOTAL CYCLES	AVG. CYCLES/MIN. (20 MINIMUM)
1ST 3 minutes	660 (idle ± 50 rpm)	132	44
2nd 3 minutes	2000 (2000 rpm ± 50 rpm)	134	44.7

Highest and lower frequency differ by at least 15 cycles/minute, and lower frequency is at least 20 cycles/minute regardless of engine speed: Yes X No ___

REMARKS:

RECORDED BY: G. FARRAND DATE: 10/10/07

APPROVED BY: D. MESSICK

WIPED AREA TEST DATA
FMVSS 104 – WINDSHIELD WIPER SYSTEM

VEH. MOD YR/MAKE/MODEL/BODY: 2007 HYUNDAI ELANTRA PASSENGER CAR
VEH. NHTSA NO: C70502; VIN: KMHDU46D97U035111
VEH. BUILD DATE: SEP/13/06; TEST DATE: OCTOBER 10, 2007
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE

Air Temperature in test area = 80 ºF (specified range of 50 to 100ºF)

Air Velocity at windshield = .5 mph (specified range of 0 to 1 mph)

Engine speed = 660 rpm (manufacturer's recommended idle ± 50 rpm)

Temperature of water spray = 78 ºF (100º F maximum)

Water spray flow rate = 71 in^3/min. (specified range of 50 to 100 in^3/min.)

Windshield wiper frequency = 68 cycles/min. (45 cpm minimum)

TEST RESULTS:

PERCENT WIPED				
WINDSHIELD AREA	ACTUAL	REQUIRED	PASS	FAIL
A	95.6%	80%	X	
B	95.9%	94%	X	
C	100%	99%	X	

REMARKS:

RECORDED BY: G. FARRAND DATE: 10/10/07

APPROVED BY: D. MESSICK

CAPABILITY TEST DATA
FMVSS 104 – WINDSHIELD WASHER SYSTEM

VEH. MOD YR/MAKE/MODEL/BODY: 2007 HYUNDAI ELANTRA PASSENGER CAR
VEH. NHTSA NO: C70502; VIN: KMHDU46D97U035111
VEH. BUILD DATE: SEP/13/06; TEST DATE: OCTOBER 10, 2007
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE

Air Temperature in test area = 80 ºF (specified range of 70 to 80ºF)

Washer reservoir fluid temperature = 75 ºF (specified range of 70 to 80ºF)

Air Velocity at windshield = .5 mph (specified range of 0 to 1 mph)

Engine speed = 660 rpm (manufacturer's recommended idle ± 50 rpm)

Number of windshield washer nozzles on the vehicle = 6

Windshield washer system activation coordinated with components of the wiper system:
Yes X No

TEST RESULTS:

CLEARED AREA PERCENTAGES						
WINDSHIELD AREA	TEST 1	TEST 2	AVG	REQ'D*	PASS	FAIL
A	93.3	93.3	93.3	75%	X	
B	95.4	95.4	95.4	75%	X	
C	100	100	100	75%	X	

*NOTE FOR REFERENCE ONLY: SAE 942b, revised Jul72, recommends capability to clear 80% of the total wash area and 90% of the wash area included in AREA C.

REMARKS:

RECORDED BY: G. FARRAND DATE: 10/10/07

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	ACT1	10/07	10/08
TEMPERATURE READOUT	OMEGA	DP41	03/07	03/08
TEMPERATURE RECORDER	OMEGA	CT485	06/07	06/08
SPRAY SYSTEM	GTL	N/A	BEFORE USE	BEFORE USE
ANEMOMETER	OMEGA	HH-600	06/07	06/08
CYCLE COUNTER	GTL	GTL	BEFORE USE	BEFORE USE
SOFT WATER	N/A	N/A	10/07	10/08
TACHOMETER	MONARCH	ACT-3	08/07	08/08
TEST DUST	AC	GM FINE	CALIBRATED DUST	CALIBRATED BY VENDOR*

*AC Inspection #503, Batch #1943, Measured with particle size roller analyzer.

SECTION 5

PHOTOGRAPHS

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 104

FIGURE 5.1
LEFT SIDE VIEW OF VEHICLE

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 104

FIGURE 5.2
RIGHT SIDE VIEW OF VEHICLE

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 104

FIGURE 5.3
¾ FRONTAL VIEW FROM LEFT SIDE OF VEHICLE

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 104

FIGURE 5.4
¾ REAR VIEW FROM RIGHT SIDE OF VEHICLE

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 104

FIGURE 5.5
VEHICLE CERTIFICATION LABEL

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 104

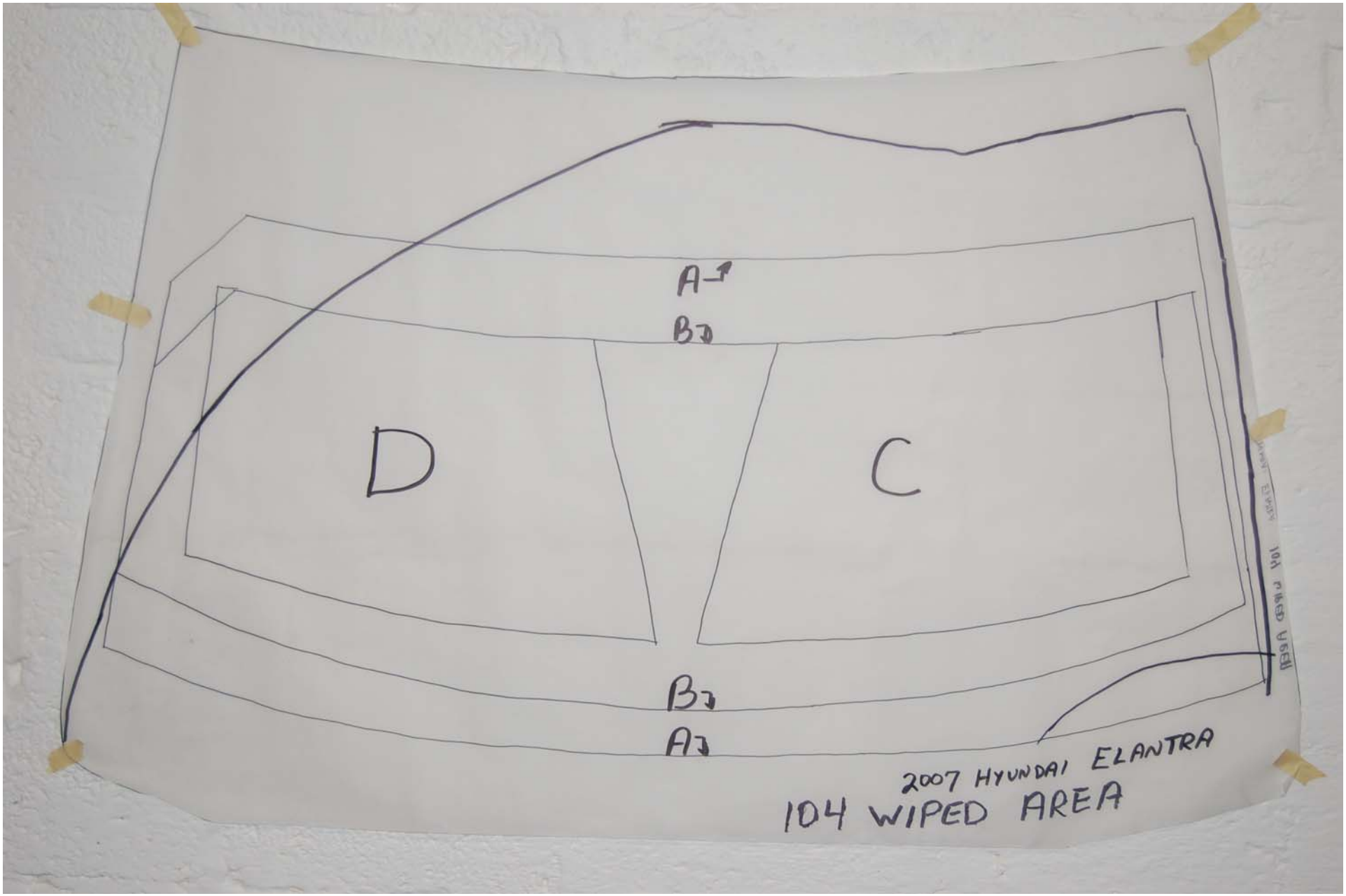
FIGURE 5.6
VEHICLE TIRE INFORMATION LABEL

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 104

FIGURE 5.7
INSTRUMENTATION AND EQUIPMENT SET-UP

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 104

FIGURE 5.8
WIPED AREA TEST IN PROGRESS



2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 104

FIGURE 5.9
WIPED AREA TEST PATTERN

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 104

FIGURE 5.10
CAPABILITY TEST #1 PRE-COATED WINDSHIELD

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 104

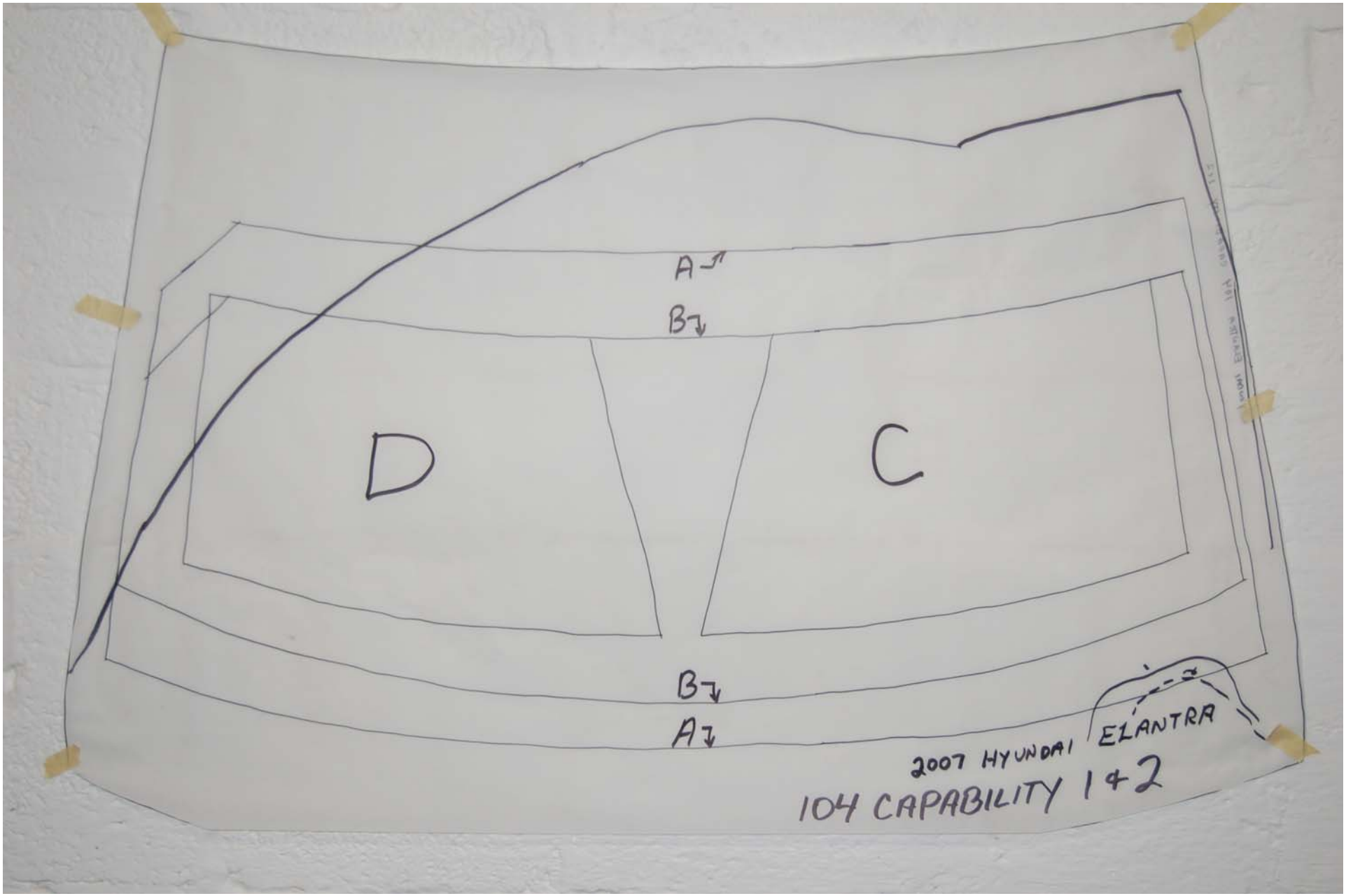
FIGURE 5.11
CAPABILITY TEST #1 IN PROGRESS

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 104

FIGURE 5.12
CAPABILITY TEST #2 PRE-COATED WINDSHIELD

2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 104

FIGURE 5.13
CAPABILITY TEST #2 TEST IN PROGRESS



2007 HYUNDAI ELANTRA
NHTSA NO. C70502
FMVSS NO. 104

FIGURE 5.14
CAPABILITY TEST #1 AND #2 PATTERN

SECTION 6

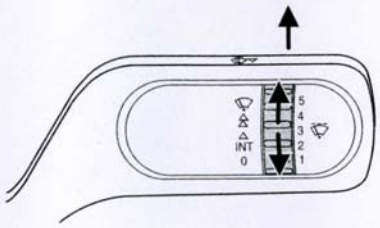
OWNER'S MANUAL INFORMATION

MULTI-FUNCTION LEVER

Windshield wiper: For intermittent operation, move control up one position.

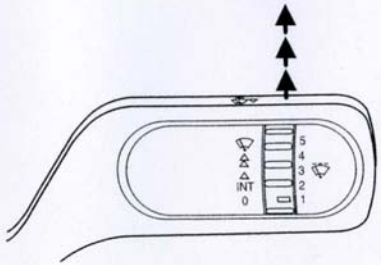
Adjust the rotary control to the desired speed setting.

Mist function: To activate mist, push control down from the OFF position and release to get one wipe.



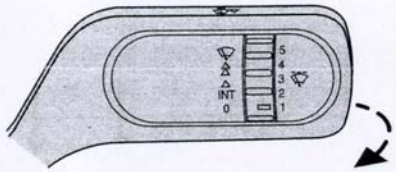
For normal or low speed wiper operation, move control up two positions from OFF.

For high speed wiper operation, move control up three positions from OFF.



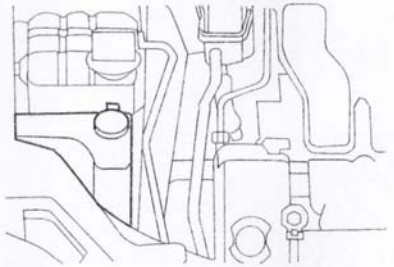
Windshield washer: Pull the end of the stalk towards you:

- briefly: causes a single swipe of the wipers without washer fluid.
- a quick pull and hold: the wipers will swipe three times with washer fluid.



- a long pull and hold: the wipers and washer fluid will be activated for up to ten seconds.

WINDSHIELD WASHER FLUID



Add fluid to fill the reservoir if the level is low. In very cold weather, do not fill the reservoir completely.

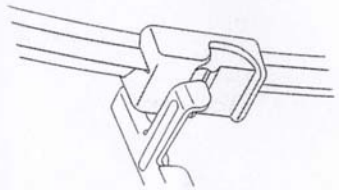
Only use a washer fluid that meets Ford specification WSB-M8B16–A2. Do not use any special washer fluid such as windshield water repellent type fluid or bug wash. They may cause squeaking, chatter noise, streaking and smearing. Refer to *Lubricant specifications* in this chapter.

State or local regulations on volatile organic compounds may restrict the use of methanol, a common windshield washer antifreeze additive. Washer fluids containing non-methanol antifreeze agents should be used only if they provide cold weather protection without damaging the vehicle's paint finish, wiper blades or washer system.

If you operate your vehicle in temperatures below 40° F (4.5°C), use washer fluid with antifreeze protection. Failure to use washer fluid with antifreeze protection in cold weather could result in impaired windshield vision and increase the risk of injury or accident.

Note: Do not put washer fluid in the engine coolant reservoir. Washer fluid placed in the cooling system may harm engine and cooling system components.

CHANGING THE WIPER BLADES



1. Pull the wiper arm away from the vehicle. Turn the blade 90 degrees from the wiper arm and remove it from the arm.
2. Attach the new wiper to the wiper arm by turning it 90 degrees it into place.

Replace wiper blades at least once per year for optimum performance. Poor wiper quality can be improved by cleaning the wiper blades and the windshield, refer to *Windows and wiper blades* in the *Cleaning* chapter.