SAE International

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J902 AUG2011

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Superseding J902 JUL2003

(R) Passenger Car Windshield Demisting and Defrosting Systems

RATIONALE

This standard is being revised and updated to unify the content with the EU standards for defrost and demist as well as update sections to comprehend new vehicle technologies that have developed over the years since the last revision.

1. SCOPE

This SAE Recommend Practice establishes for passenger cars, light trucks, and multipurpose vehicles with GVW of 4500 kg (10 000 lb) or less, as defined by EPA, and M1 category vehicles as defined by the European Commission:

a. Minimum performance standards for defrosting and demisting systems.

b. Test procedures that can be conducted on uniform test equipment by commercially available laboratory facilities.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J826 Devices for Use in Defining and Measuring Vehicle Seating Accommodation

SAE J903c Passenger Vehicle Windshield Wiper Systems

SAE J941 Motor Vehicle Drivers' Eye Locations

SAE J1100 Motor Vehicle Dimensions

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
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SAE WEB ADDRESS: http://www.sae.org

2.1.2 FMVSS Publications

Available from TP103-13, U.S. Department of Transportation National Highway Traffic Safety Administration Laboratory Test Procedure for FMVSS 103, Windshield Defrosting and Defogging Systems, http://www.nhtsa.gov/DOT/NHTSA/Vehicle%20Safety/Test%20Procedures/Associated%20Files/TP-103-13.pdf

Vehicle Test Requirements for FMVSS 103 , http://www.nhtsa.gov/DOT/NHTSA/Vehicle%20Safety/Articles/Associated%20Files/FORM%20-%

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 ISO Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 3468 Road vehicles - Windscreen defrosting systems for passenger cars - Test methods

ISO 3470 Passenger cars - Windscreen demisting systems - Test method

ISO 5897 Passenger cars - Rear-window demisting system - Test method

ISO 5898 Passenger cars - Rear-window defrosting systems - Test method

2.2.2 EEC Publication

Available from UN Economic Commission for Europe, Information Office, Palais des Nations, CH - 1211 Geneva 10, Switzerland.

EEC Council Directive 672/2010 on windshield defrost and defog

3. GENERAL

3.1 Defrosting

Means elimination of frost or ice covering the inside or outside glazed surfaces by the operation of the windshield defroster system and/or windshield wiper and washing systems.

3.2 Windshield Defroster System

Means the system consisting of all the apparatus used for cleaning the exterior surface of windshield glazing, together with the necessary devices and controls to start and stop operation.

3.3 Defrosted Area

Means the area of the glazed surfaces having a dry surface or covered with melted or partially melted (wet) frost which can be removed from the outside face by the windshield wiper system. It excludes the area of the windshield covered with dry frost. This area is defined and qualified by the following:

3.3.1 The driver's seat in the rearmost position (see Figure A1, Appendix A).

3.3.2 The 95th percentile tangential cutoff two-dimensional ellipse in accordance with SAE J941 shall be used.

3.3.3 The plan view reference line is defined as the plan view line outboard of the steering wheel centerline and parallel to the vehicle centerline. The dimension can be determined by: 0.85 x W7 + 0.075 x W3, where W3 and W7 are defined by SAE J1100 (see Figure A2, Appendix A).

3.3.4 The glazing surface reference line which is defined as the line of intersection of the glazing surface with the horizontal plane 635 mm above the manikin H-point as defined in SAE J826 (see Figure A1, Appendix A).

3.4 Windshield Wiper System

Means the system consisting of all the apparatus used for cleaning the exterior surface of windshield glazing, together with the necessary devices and controls to start and stop operation.

3.5 Windshield Washing System

Means device for storing washer solution and applying it to the windscreen outer glazed surface together with the necessary controls.

3.6 Demisting

Means the elimination of condensate from the interior glazed surface of the windshield by the operation of the demisting system.

3.7 Windshield Demisting System

Means device, or combination of devices, intended to remove the condensate from the interior glazed surface of the windshield and thus restore visibility, together with the necessary accessories and controls.

4. PERFORMANCE REQUIREMENTS

4.1 Defrosting

4.1.1 When tested in accordance with the following procedure, the defrosting system shall be capable of defrosting a minimum area as specified in Table A1 of Appendix A.

4.2 Demisting

4.2.1 When tested according in accordance with the following procedure, the defrosting system shall be capable of demisting a minimum area as specified in Table A2 of Appendix A.

5. TEST METHOD

5.1 Test Equipment

5.1.1 Cold chamber large enough to contain the complete vehicle and capable of producing and maintaining a test temperature of:

a. Defrosting: -18 °C + 3 °C/-10 °C or between -15 °C and -28 °C throughout the duration of the test.

b. Demisting: - 3 °C ± 1 °C throughout the duration of the test.

5.1.2 The chassis dynamometer load used to simulate road load shall be calculated as follows:

Using the product of the overall width (W117) and overall height (H101), as defined by SAE J1100, to approximate the vehicle cross-sectional area, determine the vehicle air resistance horsepower using Equation 1:

$$W = \frac{F^{**} \times km/h}{3.6} \quad \text{(Eq. 1)}$$

where:

F = air resistance force, [N]= 0.00275 A

then for:

**F=CdQA

where:

Cd = coefficient of drag (use 0.35 as a typical value)
Q - dynamic pressure = $1/2\rho V^2$ = 78.5 N/m^2 @ 40 km/h

where:

ρ = mass density in kg/m^2
V = velocity in m/s
A = vehicle cross-sectional area, cm^2
F = 0.35 x 78.5 x A/10000=0.00275 A

NOTE: The calculated air resistance horsepower is the maximum load that is to be applied to the chassis dynamometer. The absence of the rolling friction of the non-driving wheels of the test vehicle compensates for the fact that the driving wheels on the dynamometer rolls result in greater rolling friction than that existing on a level road.

5.1.3 Defrosting Only

5.1.3.1 Spray gun capable of capable of applying liquid spray to the outer surface of the windshield and having the following characteristics:

a. Nozzle diameter: 1.7 mm

b. Operating pressure: 350 kPa ± 20 kPa

c. Liquid flow rate: 395 ml/min

d. Projection cone diameter at 200 mm from nozzle: 300 mm

5.1.4 Demisting Only

5.1.4.1 Steam generator as described in Appendix B, and having following characteristics:

a. Water capacity: 2.25 l

b. Heat loss at boiling point at - 3 °C ± 1 °C: ≤75 W

c. Air flow rate at 50 Pa static pressure: 0.07 to 0.10 m^3/min

d. Device to regulate the steam output by controlling the input power to the heating element

5.2 Test Procedure

5.2.1 Defrosting

5.2.1.1 The test shall be carried out in a cold chamber as described in 5.1.1 at or below the temperature specified in 5.1.1: - 18 °C + 3 °C / -10 °C.

5.2.1.2 The vehicle shall be instrumented to ensure satisfactory test run and data recording. At a minimum the following instrumentation should be present on the vehicle:

a. engine coolant temperature at temperature control sensor location (thermal sensor or mechanical thermostat);

b. engine coolant temperature in and out of defroster heater unit;

c. air out of the defroster outlet;

d. temperature of the engine oil (for conventional powertrain if present);

e. temperature of the drive unit oil (for EV and PHEV vehicles);

f. the temperature of an interior surface representative of interior metal temperatures (i.e., seat rail).

5.2.1.3 Before the test the outer and inner glazed surfaces of the windshield shall be thoroughly degrease using methylated spirit or another appropriate degreasing agent. When dry, apply a solution of ammonia in water with a volume fraction of 3 to 10%, allow to dry and finally wipe with a dry clean cotton cloth or paper towel.

5.2.1.4 Before the start of test the chamber shall be stabilized at or below the temperature specified in 5.2.1.1 for not less than 14 h.

5.2.1.5 After the chamber stabilizes at the specified test temperature, the vehicle, with the engine stopped, shall be soaked at this temperature for not less than 10 h. The soak period might be shortened if engine oil temperature and seat rail temperature [or other appropriate hardware inside the cabin] are measured and temperatures are within ±3 °C of the test temperature for at least 1 h.

5.2.1.6 In the case of an electric vehicle or a plug in hybrid electric vehicle, the high voltage battery should be fully charged prior to soaking (step 5.2.1.5).

5.2.1.7 Following the vehicle soak period, an even test coating of ice shall be applied on the outer surface of the windshield by spraying an average of 0.044 g of water/cm^2 on the entire surface of the windshield by means of water spray gun described in 5.1.3.1.

The working air pressure at the gun while spraying to form an even test coating of ice shall be 350 kPa ± 20 kPa. The spray nozzle (adjusted to the fan pattern and flow shown in 5.1.3.1) shall be held perpendicular to the surface of the windshield, at a distance of 200 to 250 mm from the glass, and stroked back and forth evenly in horizontal overlapping layers until the specified quantity of liquid is applied.

5.2.1.8 Upon completion of the icing process, the vehicle shall be soaked an additional period of not less than 30 min, and not more than 40 min.

5.2.1.9 After period described in 5.2.1.8 has elapsed, one or two observers shall enter the vehicle, and the engine shall be started, if necessary by some external means. This shall mark the beginning of the test.

5.2.1.10 Total duration of the test is 40 min. Depending on the vehicle powertrain type, the powertrain load and speed through the test shall be maintained at:

a. For vehicles equipped with a conventional mechanical powertrain the first 5 min of the test period the engine speed might be that recommended by the manufacturer for vehicle warming up when starting in cold weather. For the remaining 35 min of the test, the engine shall be run at either:

   1. a speed not exceeding 50% of the speed corresponding to its maximum power rating (per ISO) or,

   2. on a chassis dynamometer the engine speed and load shall not exceed speed and equivalent load at 40 km/h in manufacturer's recommended gear (specific to SAE/FMVSS) or,

   3. the engine speed shall not exceed 1500 rpm in neutral gear.

b. For electric vehicles and plug-in hybrid vehicles or any vehicle equipped with a powertrain with a specified pure electric range, the powertrain load shall be at minimum 10% of the max powertrain load in pure electric mode and not exceeding 50% of the maximum pure electric load at -18 °C , per manufacturer's powertrain calibration specification.

c. For hybrid electric vehicles the test shall be run per 5.2.1.10, a), with the powertrain control logic per manufacturer's specification at –18 °C.

d. For vehicles equipped with high voltage battery systems, the battery shall be fully charged prior to start of test.

5.2.1.11 Additional Settings

5.2.1.11.1 The 12 V battery shall be fully charged at the beginning of the test.

5.2.1.11.2 The temperature in the test chamber shall be measured at the level of the centre of the windscreen, at a point not significantly affected by heat from the vehicle under test.

5.2.1.11.3 The horizontal component of the speed of the air cooling the chamber, measured immediately prior to the test, in the median plane of the vehicle at a point 300 mm (NOTE: for FMVSS 914.4 mm) forward of the base of the windscreen and at a level half-way between the base and the top of the windscreen, must be as low as possible and in any event less than 8 km/h (NOTE: for FMVSS: 2 mph = 3.2 km/h).

5.2.1.11.4 The engine hood, doors and the vents, except the intakes and outlets of the heating and ventilating system, must be closed. Body pressure relief valve shall be fully functional. One or two windows may be opened from the beginning of the defrosting test for a total vertical distance of 25 mm if the vehicle manufacturer so requests.

5.2.1.11.5 The windshield wipers shall be turned off and shall not be used during the test unless its control logic is such that it functions as an aid to the defrosting system and its operation commences without any manual assistance.

5.2.1.11.6 Vehicles equipped with an auxiliary blower for rear compartment heating shall have the blower turned off or at its lowest setting if off is not design intent.

5.2.1.11.7 Vehicle equipped with an auxiliary heater for rear compartment heating shall have the temperature set at the full hot.

5.2.1.11.8 All vehicle systems used in the test shall be standard production parts.

5.2.1.11.9 If standard equipment, the rear window defrost device shall be turned on if the vehicle is so equipped at the beginning of test. It shall be allowed to time out if the vehicle system is designed to do this. If this is not a standard feature for this vehicle, and the vehicle being tested is so equipped, it shall be turned off during the duration of the test.

5.2.1.11.10 If standard equipment, the heated seats shall be turned on highest setting. If this is not a standard feature for this vehicle, and the vehicle being tested is so equipped, it shall be turned off during the duration of the test.

5.2.1.11.11 Headlamps shall be turned on low beam for the duration of the test.

5.2.1.11.12 If the vehicle is equipped with an electronically controlled thermostat, the thermostat shall be set to run per normal warm-up conditions. If there is no thermostat, then no thermostat setting is required.

5.2.1.11.13 If the vehicle is equipped (and this is standard equipment on this vehicle model) with a supplemental heat source such as Positive Temperature Coefficient (PTC) heaters or fuel operated heater, it shall be turned on per the vehicle system specification.

5.2.1.11.14 If the vehicle is equipped with a heat storage device, it shall be fully charged prior to the test and set to discharge per the vehicle specification.

5.2.1.11.15 If the vehicle is equipped with a supplemental water pump, it shall be set to operate if it would normally operate at speeds less than 40 km/h or 1500 engine rpm.

5.2.1.11.16 For vehicles with remote start installed by the OEM, the test should not be run using this feature.

5.2.1.12 The defrosting system prescribed by the manufacturer shall be brought into operation with the system temperature control set to ”maximum” position.

5.2.1.13 The observer(s) shall outline the visible (clear and/or wet) defrosted area on the inside surface of the windshield, at five-minute intervals from the start of the test period.

5.2.1.14 Upon completion of the test, the defrosted pattern shall be transferred to vellum by tracing or by digital photography. The driver's side should be marked on the transferred pattern for identification purposes. If an interior auxiliary light source is used to aid in the transfer of lines, it should be placed as far to the rear of the vehicle as possible to minimize any effect of parallax.

5.2.2 Demisting

5.2.2.1 The test shall be carried out in a cold chamber as described in 5.1.1 at or below the temperature specified in 5.1.1.: - 3 °C ± 1 °C.

5.2.2.2 The vehicle shall be instrumented to ensure satisfactory test run and data recording. At a minimum the following instrumentation should be present on the vehicle:

a. engine coolant temperature at temperature control sensor location (thermal sensor or mechanical thermostat);

b. engine coolant temperature in and out of defroster heater unit;

c. air out of the defroster outlet;

d. temperature of the engine oil (for conventional powertrain if present);

e. temperature of the drive unit oil (for EV and PHEV vehicles);

f. the temperature of an interior surface representative of interior metal temperatures (i.e., seat rail).

5.2.2.3 Before the test the outer and inner glazed surfaces of the windshield shall be thoroughly degreased using methylated spirit or another appropriate degreasing agent. When dry, apply a solution of ammonia in water with a volume fraction of 3 to 10%, allow to dry and finally wipe with a dry clean cotton cloth or paper towel.

5.2.2.4 Before the start of test the chamber shall be stabilized at or below the temperature specified in 5.1.1 for not less than 12 h.

5.2.2.5 After the chamber stabilizes at the specified test temperature, the vehicle, with the engine stopped, shall be soaked at this temperature for not less than 10 h. The soak period might be shortened if vehicle instrumentation is present to prove that engine coolant, oil and interior air temperatures have stabilized at the specified test temperature.

5.2.2.6 In the case of an electric vehicle or a plug in hybrid electric vehicle, the high voltage battery should be fully charged prior to soaking (step 5.2.5).

5.2.2.7 Prior to the end of soak period described in 5.2.2.5, the steam generator container (Appendix B) shall be filled with water and started outside the vehicle. The steam generator shall be brought to boiling as soon as possible and shall be stabilized to generate 70 g/h of steam for each seating position designated by the vehicle manufacture.

5.2.2.8 Upon the steam generator stabilization per 5.2.2.7 and the soaking period per 5.2.2.5 has elapsed, the generator with its outlets shall be placed inside the vehicle in a longitudinal plane tracing the plan view reference line of the vehicle as defined in SAE J1100 at a height of 580 mm ± 80 mm above the manikin H-point as defined in SAE J826. It shall normally be placed immediately behind the front seat backrest, with the seat-back, if adjustable, set at the prescribed angle. Where the design of the vehicle precludes this, the generator may be placed in front of the backrest, in the nearest convenient position to that mentioned above.

5.2.2.9 After the generator has been operating for five minutes inside the vehicle, one or two observers shall enter the front of the vehicle, the output of the generator being then reduced by 70 g/h ± 5 g/h for each observer.

5.2.2.10 One minute after the observer or observers have entered the vehicle, the engine shall be started as indicated by the manufacturer. This shall mark the beginning of the test.

5.2.2.11 The duration of the test is 10 min. Depending on the vehicle powertrain type, the powertrain load and speed thorough the test shall be maintained at:

a. For vehicles equipped with a conventional mechanical the engine shall be run at either:

   1. a speed not exceeding 50% of the speed corresponding to its maximum power rating: or,

   2. on a chassis dynamometer the engine speed and load shall not exceed speed and equivalent load at 40 km/h in manufacturer's recommended gear.

b. For electric vehicles and plug-in hybrid vehicles or any vehicle equipped with a powertrain with a specified pure electric range, the powertrain load shall be at minimum 10% of the max powertrain load in pure electric mode and not exceeding 50% of the maximum pure electric load at -3 °C , per manufacturer's powertrain calibration specification.

c. For hybrid electric vehicles the test shall be run per 5.2.2.11, a), with the powertrain control logic per manufacturer's specification at -3 °C.

5.2.2.12 Throughout the test the vehicle demister controls must be set as recommended by the vehicle manufacturer for the test temperature.

5.2.2.13 Additional Settings

5.2.2.13.1 The 12 V battery shall be fully charged at the beginning of the test.

5.2.2.13.2 The temperature in the test chamber shall be measured at the level of the centre of the windscreen, at a point not significantly affected by beat from the vehicle under test.

5.2.2.13.3 The horizontal component of the speed of the air cooling the chamber, measured immediately prior to the test, in the median plane of the vehicle at a point 300 mm forward of the base of the windscreen and at a level half-way between the base and the top of the windscreen, must be as low as possible and in any event less than 8 km/h.

5.2.2.13.4 The engine hood, doors and the vents, except the intakes and outlets of the heating and ventilating system, must be closed. Body pressure relief valve shall be fully functional.

5.2.2.13.5 Vehicles equipped with an auxiliary blower for rear compartment heating and air conditioning shall have the blower turned off or at its lowest setting if off is not design intent.

5.2.2.13.6 Vehicle equipped with an auxiliary heater for rear compartment heating shall have the temperature set at the full hot.

5.2.2.13.7 All vehicle systems used in the test shall be standard production parts.

5.2.2.13.8 If standard equipment, the rear window defrost device shall be turned on if the vehicle is so equipped at the beginning of test. It shall be allowed to time out if the vehicle system is designed to do this. If this is not a standard feature for this vehicle, and the vehicle being tested is so equipped, it shall be turned off during the duration of the test.

5.2.2.13.9 If standard equipment, the heated seats shall be turned on highest setting. If this is not a standard feature for this vehicle, and the vehicle being tested is so equipped, it shall be turned off during the duration of the test.

5.2.2.13.10 Headlamps shall be turned on low beam for the duration of the test.

5.2.2.13.11 If the vehicle is equipped with an electronically controlled thermostat, the thermostat shall be set to run per normal warm-up conditions.

5.2.2.13.12 If the vehicle is equipped (and this is standard equipment on this vehicle model) with a supplemental heat source such as Positive Temperature Coefficient (PTC) heaters or fuel operated heater, it shall be turned on per the vehicle system specification.

5.2.2.13.13 If the vehicle is equipped with a heat storage device, it shall be fully charged prior to the test and set to discharge per the vehicle specification.

5.2.2.13.14 If the vehicle is equipped with a supplemental water pump, it shall be set to operate as if it would normally operate at speeds less than 40 km/h or 1500 engine rpm.

5.2.2.13.15 For vehicles with remote start installed by the OEM, the test should not be run using this feature.

5.2.2.14 At the end of the 10 min, the demisting pattern shall be marked and recorded.

6. APPLICATION

This SAE Recommended Practice provides a test procedure and performance guideline for evaluating passenger vehicle windshield defrosting and demisting systems. It is limited to results of tests that can be conducted on uniform test equipment in commercially available laboratory facilities. The procedures outlined in this document provide a set of instructions to be used for the purpose of obtaining uniform and repeatable laboratory test results. Although the performance obtained, therefore, might not directly relate to actual driving conditions, it serves as a laboratory performance indicator for comparing test results within or between systems. This document is intended as a guide toward standard practice but may be subject to frequent change to keep pace with experience and technical advances and this should be kept in mind when considering it use.

7. NOTES

7.1 Marginal Indicia

A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY THE SAE INTERIOR CLIMATE CONTROL COMMITTEE

APPENDIX A - DEFROSTING & DEMISTING PERFORMANCE REQUIREMENTS

A.1 DEFROSTING (PER SAE / FMVSS)

The minimum windshield area that shall be defrosted is described by the use of two specified areas identified in Table A1 as areas A and C. Each area has been established using the angles of Table A1 applied as shown in Figures A1 and A2. In Figure A1, the upper and lower boundaries of the area are established by the intersection of two planes, tangent to the upper and lower sides of the eye range contour, with the windshield glazing surface. The planes are fixed by angles above and below the glazing surface reference line. In Figure A2, the left and right boundaries of the area are established by the intersection of two planes tangent to the left and right sides of the eye range contour. The planes are fixed by angles to the left and right of the plan view reference line. Using the test procedures established in 5.2, a minimum of 80% of area A and 100% of area C should be demisted in 30 min. The areas used in determining the percentage of demisted area are those areas on the exterior glazing surface which are not within 25.4 mm of the edge of the daylight opening (pillar, division bar, header, etc.). Figure A3 illustrates all of the areas on a typical windshield. The percentage is the ratio of the demisted area within the defined area.

TABLE A1 - AREAS TO BE DEFROSTED
(REFERENCE SAE J903C)

Area	Minimum Percent Defrosted in 30 min	Angles, degrees[1] Left	Angles, degrees[1] Right	Angles, degrees[1] Up	Angles, degrees[1] Down
A	80	18	56	10	5
C	100	10	15	5	1

1. See Figures A1 and A2.

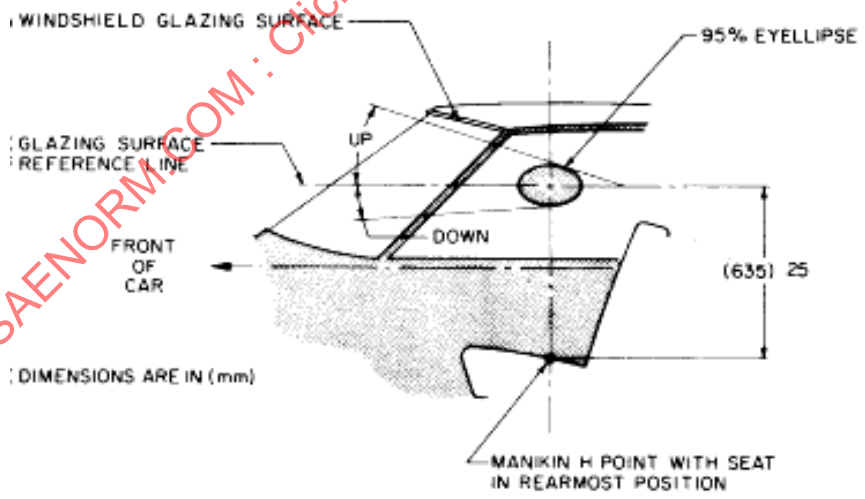

FIGURE A1 - SIDE VIEW OF AREA GENERATION