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GLOBAL REGISTRY

Created on 18 November 2004, pursuant to Article 6 of the
AGREEMENT CONCERNING THE ESTABLISHING OF GLOBAL TECHNICAL REGULATIONS FOR WHEELED VEHICLES, EQUIPMENT AND PARTS WHICH CAN BE FITTED AND/OR BE USED ON WHEELED VEHICLES
(ECE/TRANS/132 and Corr.1)
Done at Geneva on 25 June 1998

Addendum

Global technical regulation No. 6

SAFETY GLAZING MATERIALS FOR MOTOR VEHICLES
AND MOTOR VEHICLE EQUIPMENT

(Established in the Global Registry on 12 March 2008)

Appendix

Proposal and final report pursuant to Article 6, paragraph 6.3.7. of the Agreement

- Proposal to develop a global technical regulation concerning safety glazing materials for motor vehicles and motor vehicle equipment (TRANS/WP.29/AC.3/9)
- Final report on the development of the global technical regulation concerning safety glazing (ECE/TRANS/WP.29/2008/48), adopted by AC.3 at its twenty-second session (ECE/TRANS/WP.29/1066, para. 60)

UNITED NATIONS

GE.08-22950

PROPOSAL TO DEVELOP A GLOBAL TECHNICAL REGULATION CONCERNING SAFETY GLAZING MATERIALS FOR MOTOR VEHICLES AND MOTOR VEHICLE EQUIPMENT

I. OBJECTIVE OF THE PROPOSAL

1. In view of the 1998 Global Agreement, there is now an opportunity to develop an improved and harmonized safety glazing materials regulation. Moreover, the work on the global forum will provide an opportunity to consider in the new regulation international safety concerns as well as available technological developments.

2. The objective of this proposal is to develop a global technical regulation regarding safety glazing materials. The proposed regulation will be based on existing national regulations of Contracting Parties as well as international standards and regulations, but will not contain provisions regarding new materials such as glass-plastics and plastics glazings.

3. The regulation is regarded without reference to any type approval, since these would be regulated in the legislation of Contracting Parties to the global Agreement.

4. As motor vehicles are sold around the world and as they are equipped with the same glazings, it would be an improvement to have them tested under the same level. Manufacturers would benefit from a reduction of the cost of testing. The consumer would benefit by having a unique level of safety.

II. DESCRIPTION OF THE PROPOSED REGULATION

5. The global technical regulation will be developed based on best practices in the existing regulations, directives and industry standards listed below.

6. The structure of the global technical regulation will follow the gtr format adopted by WP.29 (TRANS/WP.29/883).

III. EXISTING REGULATIONS AND DIRECTIVES

7. The following regulations were taken into account during development of the new global technical regulation regarding safety glazing materials:

Europe: UNECE Regulation No. 43 (Supplement 7) Uniform Provisions Concerning the Approval of Safety Glazing Materials and their Installation on Vehicles

EU Directive 92/22/EEC on safety glazing and glazing materials on motor vehicles and their trailers

EU Directive 89/173/EEC and 2000/1/EEC on certain components and characteristics of wheeled agricultural or forestry tractors

EU Directive 97/24/EEC and 2002 /51/EEC on certain components and characteristics of two- or three-wheel motor vehicles

USA**:** American National Standard for Safety Glazing Materials for Glazing Motor Vehicle Operating on Land Highways

- Safety Code (ANSI Z26.1 – 1983)
- Safety Standard (ANSI Z26.1 – 1996)

Japan**:** Japanese Industrial Standard J IS R3211 (1998):

- Safety Glazing Materials for Road Vehicles

Japanese Industrial Standard J IS R3212 (1998)

- Test method of Safety Glazing Materials for Road Vehicles

International Voluntary Standards

ISO 3536 (1999)	Road vehicles – Safety glazing materials – Vocabulary
ISO 3537 (1999)	Road vehicles – Safety glazing materials – Mechanical tests
ISO 3538 (1997)	Road vehicles – Safety glazing materials – Test methods for optical properties
ISO 3917 (1999)	Road vehicles – Safety glazing materials – Test method for resistance to radiation, high temperature, humidity, fire and simulated weathering (1991)
DIN 52310 part 2 (1991)	Headform impact test on safety glazing materials for road vehicles with deceleration measurement.

FINAL REPORT ON THE DEVELOPMENT OF THE GLOBAL TECHNICAL REGULATION CONCERNING SAFETY GLAZING

I. PRELIMINARY REPORT ON THE DEVELOPMENT OF A GLOBAL TECHNICAL REGULATION CONCERNING SAFETY GLAZING MATERIALS FOR MOTOR VEHICLES AND MOTOR VEHICLE EQUIPMENT

A. INTRODUCTION

8. The objective of this proposal is to develop a global technical regulation regarding glass of safety glazing materials. It will not contain provisions regarding new materials such as plastic glazings. The gtr proposal was constructed on the basis of UNECE Regulation No. 43, American National Standard for Safety Glazing Materials and Japanese Industrial Standard. It does not include type approval, plastic glazing and installation requirements. The main differences to UNECE Regulation No. 43 are mentioned in a preamble.

B. CURRENT STATUS

9. The working group of experts on safety glazing has worked out after six meetings a draft gtr "Proposal for a new Global Technical Regulation concerning Safety Glazing Materials for Motor Vehicles and Motor Vehicle Equipment" (TRANS/WP.29/GRSG/2005/9) which was transmitted by the expert of Germany on account of the order TRANS/WP.29/2004/27 to GRSG and was discussed at the eighty-eighth GRSG – meeting from 18 to 22 April 2005 under agenda item 4.1. of the agenda. The working group consisted of glass experts from governmental administrations, technical services, glass industry and automotive organizations from different countries worldwide.

C. FUTURE STEPS

10. After discussion and agreement in GRSG the draft gtr will be sent to WP.29 for voting.

II. SECOND REPORT ON THE DEVELOPMENT OF A GLOBAL TECHNICAL REGULATION CONCERNING SAFETY GLAZING MATERIALS FOR MOTOR VEHICLES AND MOTOR VEHICLE EQUIPMENT

D. INTRODUCTION

1. History of the global technical regulation (gtr)

11. During the one-hundred-and-twenty-sixth session of the World Forum for Harmonization of Vehicle Regulation (WP.29) in March 2002, AC.3 concluded their considerations of priorities for developing future global technical regulations. WP.29 adopted the 1998 Global Agreement Programme of Work, which included safety glazing, and decided to start the work on safety glazing, at the eighty-third session of the Working Group on General Safety (GRSG) in October 2002, by creating an informal group to draft the global technical regulation (gtr).

12. At the one-hundred-and-thirty-second session of the World Forum for Harmonization of Vehicle Regulations (WP.29) in March 2004, the formal proposal to develop a gtr on safety glazing was adopted (TRANS/WP.29/AC.3/9), with a restriction of its scope to glass safety glazing (excluding other materials such as plastics).

13. While some Contracting Parties allow the use of plastic glazing for window panes in vehicles, other Contracting Parties prohibit plastic glazing due to its limited durability. Historically, plastic glazing degrades gradually over time, particularly due to the effects of weather, radiation, oxidation and mechanical abuse. In such cases, the visibility of the glazing is greatly reduced. Therefore, to avoid contentious, time-consuming discussions and to expedite the development of the gtr at the one-hundred-and-thirty-third session of WP.29, the Executive Committee of the 1958 Agreement (AC.3) agreed to exclude plastic glazing from the gtr.

14. An informal group was established under the Chairmanship of Germany, the sponsor of the gtr. The informal group developed and submitted a draft gtr to the Working Party on General Safety Provisions (GRSG) for its ninetieth session. The first report was submitted to WP.29 for its one-hundred-and-thirty-sixth session, in June 2005. Based on comments from Canada and the United States of America, the draft was returned to the informal group for further consideration.

15. Two issues were raised in the informal group, the installation and the markings. Existing national or regional regulations/legislation include prescriptions on which kind of glazing may or may not be installed at certain locations and/or in certain vehicles. In particular, the requirements for light transmission levels in glazing installed in rearward vision areas vary widely. Existing national or regional regulations also specify marking requirements that indicate the type of material and/or the regulations/legislation it meets. The informal group was not clear as to whether a global marking to demonstrate compliance with the gtr requirements would be proper within the scope of a gtr. Responding to questions from the informal group, at the one-hundred-and-thirty-seventh session of WP.29, in November 2005, AC.3 agreed that the gtr would not include installation requirements and that the informal group could consider the possibilities to include markings in the gtr (TRANS/WP.29/1047, para. 96). However, at the one-hundred-and-fortieth session of WP.29, in November 2006, the European Commission submitted a proposal concerning markings for gtrs in general. As this proposal would be discussed at later sessions of WP.29 only markings concerning the type of material are included in this gtr.

2. Summary

16. The draft gtr specifies performance requirements for various types of glazing (i.e., laminated and toughened glass) intended for installation in Category 1 and 2 vehicles as defined in Special Resolution No. 1. The requirements apply to glazing as an item of equipment, and do not include installation requirements for vehicles. Performance requirements for some of the materials are different if the material is intended for installation as a windscreen or as a pane. The draft gtr includes requirements and tests to ensure that the mechanical properties, optical qualities and environmental resistance of glazing are satisfactory.

17. Four tests and requirements are used in the gtr for mechanical properties: a fragmentation test, a 227 g steel ball, a 2.26 kg steel ball and a 10 kg head-form. The first three appear in all of

the national or regional regulations. The fragmentation test in this gtr is similar to those included in UNECE Regulation No. 43 "Uniform Provisions Concerning the Approval of Safety Glazing and Glazing Materials." The 227 g steel ball and 2.26 kg steel ball tests are similar in the national or regional regulations examined and the differences were resolved in the gtr. The major difference from all existing regulations is the drop height for the small ball test for uniformly toughened glass panes. Based upon analysis conducted by Japan, which demonstrated that the force from a drop height of 2.0 m represented the force of a typical object impacting a pane, it was decided that a drop height of 2.0 m could be retained. The head-form test in this gtr specifies one drop height, and not two as in European and Asian regulations.

18. Three types of optical qualities are addressed by the gtr: light transmission, optical distortion and double image. The minimum light transmittance level for glazing required for the driver's forward field of vision is 70 per cent as it is in North American and Asian regulations, and not 75 per cent as it is in European regulations. This is justified by costs/benefits analysis. The test procedure is based on the UNECE test procedure. The main difference from the other tests in the national or regional regulations examined was not the requirements, but the test procedure. This was resolved by selecting the test procedure that was most similar to real-world conditions.

19. For environmental resistance, the gtr includes requirements related to temperature change, fire, chemical resistance, abrasion, radiation, high temperature and humidity. The first four of these were common to all the examined regulations. Minor differences in the other three were resolved for the gtr.

20. The informal group understands that research to update some of the environmental tests is currently being conducted within the glazing industry. However, for the time being, the gtr can only consider the available practice and test requirements. Once the new test procedures/test equipments are validated and updated by the industry, proposals could be made to update the gtr, accordingly. Other areas that could be the subject of future proposals to upgrade the gtr include installation provisions, plastic glazing and unified markings, and are subject to the approval by WP.29 and AC.3.

3. Background

21. Standards covering the performance requirements for vehicle glazing have been in existence in Europe and in the United States of America since the late 1930s. Early standards include the American National Standard for Safety Glazing Materials for Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways – Safety Standard ANSI Z26 and the British Standard 857 "Safety Glass for Land Transport." These early voluntary standards form the basis for later mandatory national standards.

22. Due to the absence of candidate regulations in the Compendium, a number of national or regional regulations were examined in developing this gtr, including those of Canada, China, the UNECE, Japan and the United States of America. Voluntary standards were also examined, including those of American National Standard Institute (ANSI) and the International Standardization Organization (ISO).

23. The summary chart in the Appendix compares the existing regulations in Europe, the United States of America and Japan for the most commonly used types of glazing materials. In many cases the technical requirements are the same or similar. However, there are some differences in the requirements for mechanical properties and optical qualities.

4. Meetings of the informal working group

24. The group convened fourteen times since summer 2002. The meetings were attended by the representative of the main Contracting Parties to the 1998 Agreement and by the main non-governmental organizations.

The group held the following meetings:

(a) 14 June, 2002, Brussels, Belgium
(b) 15 October, 2002, Geneva, Switzerland
(c) 5 May 2003, Geneva, Switzerland
(d) 21 October, 2003, Geneva, Switzerland
(e) 19 April, 2004, Geneva, Switzerland
(f) 12 October, 2004, Geneva, Switzerland
(g) 9 June, 2005, Washington, U.S.A
(h) 11 October, 2005, Geneva, Switzerlan d
(i) 21-22 February, 2006, Brussels, Belgium
(j) 24 April, 2006, Geneva, Switzerland
(k) 17 October, 2006, Geneva, Switzerland
(l) 23-24 January 2007, Brussels, Belgium
(m) 16 April 2007, Geneva, Switzerland
(n) 23 October 2007, Geneva, Switzerland

E. TECHNICAL RATIONALE AND JUSTIFICATION

25. Vehicle glazing contributes to vehicle safety in numerous ways. For this reason, it shall satisfy a set of performance requirements. The following general properties are desired:

(i) Vehicle glazing shall have good mechanical strength and fracture resistance. Mechanical strength will help to ensure that objects, such as road debris thrown against the glazing do not penetrate into the occupant compartment. Mechanical strength can also help prevent occupant ejection in the event of a crash. Good fracture characteristics minimize the likelihood of injury in the case of breakage;
(ii) Vehicle glazing shall also have good optical properties. This will ensure that the glazing is sufficiently transparent to provide a good view of the road and does not cause any distortions in the vision;
(iii) To ensure continued performance throughout the life of the vehicle, the glazing should be resistant to conditions encountered in normal usage. This includes atmospheric humidity, temperature fluctuations and abrasion. For glazing with exposed plastic surfaces, this would also include chemicals and combustion.

1. Existing requirements/tests not included in the gtr

26. The European and Asian regulations include a requirement for colour recognition. The requirement was originally adopted to prevent confusion concerning traffic signals. The North American regulations do not include such a requirement, nor was it adopted by ISO. Experience has shown that colour distortion is not a problem at the light transmission levels allowed by any national or regional regulation for windscreens. For lack of safety justification, the requirement is not included in the gtr.

27. The North American regulations include a 4.99 kg shot bag test. The test requires a leather bag filled with lead shot. Experience has shown that it is difficult to obtain consistent results because variations in the suppleness of the leather play a significant role in the distribution of force on the impact area. For lack of objectivity, the test was not included in the gtr.

28. The North American regulations also include a 198 g dart test. The dart test is a test that causes fracture and delaminated areas for laminated windscreens and panes. The 227 g ball test evaluates the same characteristics. Because the dart is very close in mass to the 227 g ball, the tests provide similar information. For this reason the 227 g ball test is included in the gtr only because the slightly increased weight makes the test slightly more severe.

29. The European and Japanese regulations include head-form tests at both 1.5 m and 4 m drop heights. The test at the 4 m drop height is not included in this gtr. The 4 m drop height test shall be conducted on specially manufactured test pieces rather than normal production parts. The primary benefit of this test is to assess the penetration resistance, which is already assessed in other test protocols included in the gtr.

2. Common requirements in all of the regulations

30. All of the regulations considered include identical requirements for glazing with an exposed plastic layer. These requirements are tested for the resistance to:

(i) Temperature change;
(ii) Fire;
(iii) Chemicals (e.g., cleaning compounds);
(iv) Abrasion.

31. By its nature, glass glazing is resistant to these factors. However glazing with an exposed plastic face could have low resistance. If the glazing were not resistant to temperature changes, chemicals or abrasion, the ability of a driver to see through the glazing would be compromised. If the glazing permitted a fire to spread on an exposed plastic surface this could also be a hazard to the occupants of the vehicle. Because a safety justification for these requirements exists, they were included in the gtr.

3. Mechanical properties

32. There are basically two types of glass-based glazing used in automotive applications, the toughened (also known as tempered) and the laminated. There are differences between them in the manufacturing process, weight, cost, strength and fracture properties.

33. Toughened glass is produced using a manufacturing method (heat tempering) that introduces internal stresses in glass. Heat tempering increases the mechanical strength of the glass, so it resists to breakage. In the event that the glass does break, it shatters into numerous small, blunt-edged pieces rather than large and/or sharp fragments, reducing the risk of injury to an occupant struck by the broken glazing.

34. Laminated glazing consists of two glass panes sandwiching a plastic interlayer, which is inserted after the glass panes have been bent to the desired shape. The total assembly is highly resistant to penetration, and in the case of breakage, the many small, blunt fragments are held in place by the interlayer. This reduces the risk of head injury. In the case of an impact with a foreign object, emergency visibility is maintained. For these reasons this gtr only specifies requirements for laminated glazing windscreens, using laminated glass or glass-plastics.

35. For mechanical properties four types of tests are included into the gtr:
(i) fragmentation test;
(ii) 227 g steel ball test;
(iii) 2.26 kg steel ball test; and
(iv) 10 kg head-form test.

36. The purpose of the fragmentation test is to determine whether the glazing is causing injury when it does breaks. In the case of breakage, it is desired that the glazing shatter into very small, blunt pieces rather than large, sharp fragments and thereby significantly reducing the risk of serious injuries. The fragmentation test is applicable only to toughened and not laminated panes because in the later case the majority of fragments will be held in place by the interlayer. The ability of the interlayer to hold these fragments in place is evaluated in the 227 g ball test.

37. There are two significant differences between the North American regulations and the European and Asian regulations. The North American regulations specify only one breaking point, while the others specify four breaking points. The North American regulations specify that the largest fragment cannot exceed a specific weight, while the European and Asian regulations require a minimum and maximum number of fragments and specify additional limits on the maximum length and area of any single fragment.

38. When a toughened pane is broken, the fracture pattern observed depends not only on the degree of thermal toughening introduced in the processing, but also on the peripheral shape of the pane and the location of the point of fracture. There is a complex interaction between the developing crack and the resultant stress wave that is reflected back from the edges of the pane. As a general rule the centre break position is the most critical. However, if a pane has a significant degree of curvature at the lateral extremities, a geometric centre break point can mask toughening issues. Adding an additional fragmentation point in the region of smallest radius, it can be verified if the glass has been properly toughened.

39. After reviewing all of these regulations the experts agreed that two breaking points could be specified and adopted the minimum number of fragments count technique with additional limits on fragment size and shape. The centre breaking position is specified for all panes. For panes with complex curves, an additional test point is introduced at the place where the minimum radius of curvature "r", on the longest median, is less than 200 mm. Specifying this point means that the additional test points in the European and Asian regulations are not required. The value of 200 mm is based on tests carried out by the European test laboratories e.g. Material Prüfungs-Amt (MPA), British Standard Institute (BSI) and L'Union Technique de l'Automobile, du Motocycle et du Cycle (UTAC).

40. Both the North American technique of weighing the largest fragment and the European/Asian technique of counting fragments are intended to ensure that the glazing break into a large number of small fragments to reduce the severity of lacerations risks.

41. While the North American technique is a simpler test to perform, the recent use of very thin toughened glazing would permit a significant increase of the fragment size. For this reason assessing the number of fragments and limiting their area seemed to provide the greatest measure of safety.

42. The purpose of the 227 g steel ball test is to assess the resistance of the glazing to impacts from stones or other flying objects that might be encountered in everyday use. For uniformly toughened glass panes, in Europe and Asia, a drop height of 2.0 to 2.5 m, depending on the thickness of the glazing, is specified. In the United States of America, a drop height of 3.05 m is specified. Tests in Japan led to the conclusion that a drop height of 2.0 m is sufficient for this type of glazing. The typically encountered stone was determined to have a mass of 2-3 g. In the case of a windscreen, an impact velocity of 150 km/h may be reached. However, the impact velocity on a windscreen is largely determined by the speed of the vehicle, which is not the case for panes where the impact velocity will be lower. Assuming a worst-case impact velocity of 150 km/h, the impact energy of a 3 g object would be equivalent to the impact energy of the 227 g ball dropped from a height of 1.17 m. Therefore, it was decided that the lowest height, 2 m, used in any national or regional regulation, would be sufficient to assess a pane impacted, penetrated by a stone or other small object. This lower drop height will also allow the use of thinner panes, resulting in a weight reduction that could contribute to lower fuel consumption.

43. For other glazing the differences between the regulations examined generally related to the drop height used during the test. The gtr specifies a drop height of 9 m as in the North American regulations for windscreens. Unlike panes, the impact force on windscreens is difficult to determine as it depends on the velocity of both the object and the vehicle. Quite frequently existing glazing is manufactured to meet the most severe test conditions in existing regulations around the globe, and therefore the feasibility of meeting the more severe standard is demonstrated. Therefore, the North American test height was chosen to ensure that the glazing is resistant to penetration under ambient conditions. The drop heights in the European and Asian regulations were kept for the low and high temperature tests, to assess the interlayer performance over extreme temperature conditions.

44. The purpose of the 2.26 kg steel ball test is to assess the penetration resistance of laminated glazing materials for windscreens to impact from a heavy object. The U.S.A. regulation requires a resistance to penetration from 3.66 m while the European and Japanese regulations require performance from 4.0 m. Many windscreens produced in the U.S.A. are dual certified for both 3.66 m and the 4.0 m performance levels already. Therefore the higher height of 4.0 m was selected for inclusion in the gtr.

45. The purpose of the 1.5 m head-form impact test is to ensure that when impacted by a large blunt object, the windscreen breaks in a controlled manner without significant penetration, showing the characteristic bulge with radial and circumferential cracks, observed in typical road accidents. The requirement of the 2.26 kg ball drop test, which is used to assess the penetration resistance of the laminated glazing material is considered satisfactory even if no breakage occurs.

4. Optical properties

46. The relationship between light transmission and a driver's visual needs is complex. Factors involved include visual acuity, prevailing contrast levels, vehicle speed and the location of the glazing in the vehicle. Body tinted heat absorbing and heat reflecting darker glazing is desired to reduce the amount of heat from solar radiation entering the vehicle, however, darker glazing also reduces the ability to see out of the vehicle. In developing the gtr, there was agreement that glazing requisite for the driver's primary visibility should exhibit good light transmission properties. All existing national or regional regulations require higher levels of light transmission for glazing at locations that the driver would use for his forward field of view, e.g., windscreens and some side panes. In many instances where existing national or regional regulations allow lower levels of light transmission at locations to the rear of the driver, this allowance is tied to a requirement for rear-view mirrors. The divergence in national legislation regarding light transmission levels for rearward field of view glazing is one of the main issues that led the informal group to request advice from AC.3 on including provisions in the gtr when various types of glazing could be installed in a vehicle. However, since AC.3 determined that the gtr should not include installation provisions, making lower light transmittance levels provisional on other items of equipment could not be included in this gtr. Therefore, the use of darker glazing to the rear of the driver is at the discretion of the Contracting Parties.

47. With regard to the light transmittance requirements for forward vision, the gtr specifies a minimum level of 70 per cent light transmittance. Current national or regional regulations specify either 70 per cent (North America) or 75 per cent (UNECE). Laboratory test studies 1/ and vehicle accident data do not show any influence on safety with the lower minimum limit for light transmission. Therefore this level was selected for the gtr.

48. The gtr also specifies limits on distortion and double image. If the glazing caused too much distortion or created double images this could lead to driver confusion. The main differences among the existing national or regional regulations are not in the levels specified but in the test methods for both of these requirements. In the North American and Canadian

1/ Report PPAD 9/33/39 "Quality and Field of Vision – A Review of the Needs of Drivers and Riders," Institute of Consumer Ergonomics – Loughborough. February 2003.

regulations, the test method specifies measuring at normal incidence (perpendicular) to the glazing surface. By contrast, the European and Asian regulations specify measuring in defined vision areas at the intended installation angle of the glazing. Because the European and Asian regulations evaluate the image seen by the driver, these tests were included in the gtr.

49. At the time many of the early regulations were developed, the angle of installation of most windscreens was very low, that is close to vertical. Modern windscreens can be complex in terms of styling. They are larger, with high angles of inclination (typically in excess of 60 ° to the vertical) and shaped to bend into the bodywork to improve aerodynamics. Distortion is a function of the angle of incidence and can be up to 10 times greater at an inclination of 62 ° than at normal incidence. For this reason, the gtr specifies testing at the intended installation angle to ensure that the distortion measured accurately reflects what a driver might encounter.

50. The gtr specifies optical testing in the vision areas currently specified in the European and Asian regulations. Because modern windscreens are larger, the actual area used by the driver under normal conditions is limited. Because of the shaping of the windscreen at the margins, often curving in more than one direction, there are practicality concerns with testing the entire windscreen. The areas specified in the European and Asian regulations are based on Society of Automotive Engineers (SAE) Recommended Practice J941 "Motor Vehicles Drivers Eye Locations." The Recommended Practice is based on a study involving over 2300 drivers, with a male-to-female ratio of one-to-one, performing a straight ahead driving task (SAE Paper 650464). Elliptical contours defining a range of eye positions were developed from a statistical analysis of the physiological data. These contours, or eye ellipses, offer a representation of a driver's eye location and can be used to determine what a driver could see. Balancing the practicality concerns with the fact that the eye ellipses offer a good estimate of the windshield area that could typically be used by the driver, testing only in these areas is specified.

5. Atmospheric resistance

51. The tests in this category are intended to ensure that the glazing will withstand exposure to atmospheric conditions that might be encountered in normal use. These tests only apply to laminated glazing and glazing with an exposed plastic face. Glass is by its nature a stable and durable product and would not be affected by the atmospheric conditions. Plastic can be less durable and stable, as are the materials used to bond the layers. In addition, if improperly constructed, air or moisture could penetrate between the layers. The following tests ensure that durable plastic and good construction are materials used in these products.

52. The first of these tests, resistance to radiation, involves exposure to a UV light source. The major difference between the American and UNECE Regulations is that the American regulation specifies 100 hours exposure, using a specified radiation source, while the UNECE Regulation specifies 100 hours of exposure at 1400 W/m^2. Since the UNECE Regulation ensures a constant level of exposure and allows for alternative sources of UV radiation during testing, it is used in the gtr.

53. The remaining atmospheric tests, resistance to high temperatures and resistance to humidity, determines whether the glazing can withstand prolonged exposure to high temperatures and humidity it could be exposed to during its expected life. The differences

between the existing regulations are minor differences in the maximum distance from an edge within which a defect is allowed to appear during the test. The distances specified in the European and Asian regulations were chosen for the gtr as they were even multiples of 5 and because they include a second, slightly larger, limit for edges that had to be cut to conduct the test. Cutting glazing introduces stress and it is reasonable to allow defects for a slightly larger difference when such an edge would not exist in a production piece.

6. Application

54. The gtr is applicable to glazing intended for installation in Category 1 and 2 vehicles as defined by Special Resolution No. 1. These definitions cover vehicles glazing included within the scope of both the existing regulations and the 1998 Agreement. As explained above, based on guidance from WP.29, the gtr specifies requirements for glazing as an item of motor vehicle equipment and not for the vehicle.

7. Markings

55. Existing national or regional regulations require markings on glazing that generally fall into three categories:

(i) The type of material the glazing is constructed from;
(ii) The manufacturer of the glazing; and
(iii) The regulation(s) the glazing is manufactured to comply with.

56. In the first category, the regulations vary only in the symbol used for each material, not the content. In the second category, some regulations require a trade name or mark, some require an assigned identifier, and others require a higher level of detail, for example, not just the manufacturer but the actual plant where the glazing was fabricated. The third category generally reflects differences in enforcement mechanisms in various countries.

57. This gtr specifies marking requirements for only the first category. The marking system in UNECE Regulation No. 43 was the starting point. However, some additional markings were added to make sure each type of glazing which has unique requirements under the gtr has a unique marking.

58. Contracting Parties will be able to continue to require additional markings in one or both of the other two categories. While some manufacturers would also like the gtr to include markings in these categories, thus eliminating the need to add multiple markings if the glazing is sold in more than one country, they are not included at this time.

8. Sampling

59. Whenever possible it is desirable to test actual production parts and/or test pieces cut from production parts. However, in the abrasion and 1.5 m head-form test for double-glazed panes, the test piece shall fit a holder or support frame. Since it is not practicable to design a new holder or support frame for each production part, these tests specify the testing of specially prepared test pieces. It is expected that the test pieces would be identical to the glazing in production parts, except for the shape and/or size.

E. CONCLUSION

60. GRSG at its 93rd session agreed to recommend for adoption by AC.3 the draft gtr on safety glazing for its establishment in the Global Registry.

Appendix

Comparison between UNECE Regulation No. 43, Japan Safety Regulations for Road Vehicles and FMVSS 205

Laminated windscreens

TEST	EUROPE UNECE Regulation No.43	JAPAN Safety Regulations for Road Vehicles, Article 29	USA FMVSS 205	DRAFT GLOBAL TECHNICAL REGULATION
Windscreen optics	Tests on windscreens • using defined vision areas • at the installation angle • Test method ISO 3538	Tests on windscreens • using defined vision areas • at the installation angle • Test method ISO 3538	Test of 12" squares which may be cut from the most curved part of the windscreen • no defined vision area • not tested at the installation angle • not as ISO 3538	As UNECE Regulation No. 43
Light transmission	TL ≥ 75 per cent Test method ISO 3538	TL ≥ 70 per cent Test method ISO 3538	TL ≥ 70 per cent Test method ISO 3538	TL ≥ 70 per cent i.e. as for USA, Japan and Directive 77/649/EEC Forward Field of Vision
Light stability High temperature Humidity Fire resistance	Test method as ISO 3917 Burning rate <250 mm/min	Test method as ISO 3917 Burning rate < 89 mm/min	Test method as ISO 3917 but The evaluation for high temperature and humidity tests not as Europe and Japan Burning rate < 88.8 mm/min	Test method as ISO 3917 Evaluation as Europe and Japan CBurning rate < 90 mm/min
Impact 227g Ball	Test method ISO 3537 Tests at + 40°C and - 20°C Varying drop heights according to thickness	Test method ISO 3537 Test at + 40°C and - 20°C Varying drop heights according to thickness	Test method ISO 3537 Test at 25°C Standard drop height	Test method ISO 3537 Test at + 40°C and - 20°C One standard drop height at each temperature

Laminated windscreens (continued)

TEST	UNECE Regulation No. 43	JAPAN Safety Regulations for Road Vehicles, Article 29	USA FMVSS205	DRAFT GLOBAL TECHNICAL REGULATION
Impact 198g Dart	No test	No test	Test at 25° C. No ISO test.	No test
Penetration Resistance 2.26 kg ball	Test method: ISO 3537 Drop height 4.0 m	Test method: ISO 3537 Drop height 4.0 m	Test method: ISO 3537 Drop height 3.66 m	As UNECE Regulation No. 43
Abrasion Resistance	Test method: ISO 3537	As UNECE Regulation No. 43	As UNECE Regulation No. 43	As UNECE Regulation No. 43
Headform Impact Test	Test method: ISO 3537 Evaluation of penetration resistance and breaking pattern 4 m drop test on flat test pieces. 1.5 m drop test on windscreens	Test method: ISO 3537 Evaluation as UNECE Regulation No. 43 Testing as UNECE Regulation No. 43	No test	The headform 1.5 m drop test on windscreens is included. (The ECE R43 and Japanese test at 4.0 m on flat test pieces is not included)
Colour Identification	Test to verify that traffic light colors can be recognized. Not an ISO test	As UNECE Regulation No. 43	No test	No Test

Toughened bodyglass

Test	UNECE Regulation No. 43	JAPAN Safety Regulations for Road Vehicles, Article 29	USA FMVSS 205	DRAFT GLOBAL TECHNICAL REGULATION
Impact test 227 g Ball	• Test method: ISO 3537 • Drop heights: thickness ≤ 3.5 mm – 2.0 m thickness > 3.5 mm - 2.5 m • Flat 300 x 300 mm test pieces or finished products	• ISO 3537 • Drop heights as ECE R43 • Flat 300 x 300 mm test pieces	• Test method: ISO 3537 • Drop height: 3.05m • Flat 305 x 305 mm test pieces	As UNECE Regulation No. 43 Standard drop height: 2.0 m
Impact test 4.99 kg shot bag	No test	No test	No ISO test. Drop height: 2.40 m • Flat 305x305mm test pieces.	No test
Abrasion test	No test for the glass surface If plastic coated, then: test method: ISO 3537	As ECE R43	• Test method: ISO 3537 • Carried out on bodyglass requisite for driving visibility	As UNECE Regulation No. 43
Light transmission	• Test method: ISO 3538 • In areas requisite for driving visibility: • $T_L \geq 70$ per cent In areas not requisite for driving visibility: T_L no lower limit	As UNECE Regulation No. 43	• Test method: ISO 3538 • For passenger cars the TL limit is ≥ 70 per cent , except for rooflights For other vehicles the limits are as UNECE Regulation No. 43 • and Japan.	As UNECE Regulation No. 43
Optical quality	No test	Sidelights requisite for driving visibility	No test	As UNECE Regulation No. 43

Toughened bodyglass (continued)

Test	ECE Regulation No. 43	JAPAN Safety Regulations for Road Vehicles, Article 29	USA FMVSS 205	DRAFT GLOBAL TECHNICAL REGULATION
Fragmentation	Test procedure ISO 3537 • Production parts are broken using a spring loaded centre punch or pointed hammer from 4 defined breaking points • The minimum particle count allowed is 40 (in any 5x5 cm sided square) with an upper limit of 450 for a thickness < 3.50 mm. 400 for thickness >3.5 mm • No elongated particles (splines) in excess of 7.5 cm are permitted • The maximum particle size allowed is 3 cm^2 • NB: Some deviations on the above are permitted. Example: splines up to 10 cm	ISO 3537 Requirements are similar to those specified in UNECE Regulation No. 43 Some small differences in the allowed deviations Deviation examples: • splines up to 15 cm • in case particle count < 40, then: particle count >= 160 in any 10 x 10 cm square is acceptable	Fragmentation test as ISO 3537, with only one defined break position (25 mm inboard of the mid-point of the longest edge) The interpretation of results is based on the weight of the largest fragment, which shall not exceed 4.25 g. This equates to the following maximum particle sizes: 3 mm thickness: 5.6 cm^2 4 mm thickness: 4.2 cm^2 5 mm thickness: 3.4 cm^2 No evaluation of the length of fragments.	As UNECE Regulation No. 43, with some changes: • a single centre break position is specified. • the upper particle count limit is removed. Minimum limit remains at 40. • the elongated particle limit is raised from 7.5 to 10 cm • Determination of the largest particle weight rather than of the area, e.g. for glass up to 4.5 mm thickness the weight shall not exceed 3.0 g. This equates to: 3.9 cm^2 for glass 3 mm 3.0 cm^2 for glass 4 mm Unlike UNECE Regulation No. 43 and Japan, no deviations are permitted.

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