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Automotive Safety Glazing Manual — SAE J906



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SAE AUTOMOTIVE GLAZING MATERIALS
AND STANDARDS SUBCOMMITTEE

J. C. WIDMAN, (Chairman),
Ford Motor Co.

H. M. ALEXANDER, Libbey-Owens-Ford Glass Co.; WILLIAM BAMFORD, Libbey-Owens-Ford Glass Co.; GRIFFITH BOWEN, Plastics Dept., E. I. du Pont de Nemours & Co.; R. H. COOK, Int'l Harvester Co.; ERNEST EDGE, Chrysler Corp.; H. K. GANDELOT, General Motors Corp. (Ret); P. O. JOHNSON, Fisher Body Div., GMC; L. A. KEIM, Pittsburgh Plate Glass Co.; EDWARD LACEY, Plastic Div., Monsanto Co.; W. C. LANG, Chrysler Corp.; G. J. LAWTON, Ford Motor Co.; T. J. McKEY, American Motors Corp.; L. H. NAGLER, American Motors Corp.; NORMAN NITSCHKE, Permaglass, Inc.; L. W. PARR, Chrysler Corp.; B. W. PRESTON, Ford Motor Co.; O. I. RUGG, Ford Motor Co.; J. D. RYAN, Libbey-Owens-Ford Glass Co.; D. J. SCHRUM, Studebaker Corp.; K. A. STONEX, General Motors Corp.; H. A. TUTTLE, Ford Motor Co.; R. G. WHITTEMORE, Pittsburgh Plate Glass Co.

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SAE AUTOMOTIVE SAFETY GLAZING MANUAL

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PREFACE

PURPOSE

This SAE Automotive Safety Glazing Manual is intended to provide automotive engineers and designers unfamiliar with glazing materials with a basic guide to the characteristics of safety glazing materials and information on usage. This report reflects the knowledge and experience which automotive and glazing engineers and scientists have accumulated in over forty years of cooperative engineering activity on SAE Glazing Committees.

The SAE Automotive Glazing Materials and Standards Subcommittee, under whose direction this report was developed, recognizes that the subject matter of this report is a dynamic area of motor vehicle engineering. Its facets are subject to continual modification by technological improvements in design and application. It is recognized too that vehicle visibility requirements are constantly influenced by such changes in the environment, in which the vehicle operates, as superhighways and increased traffic conditions. For these reasons, the subcommittee emphasizes that the current report is not a final and complete compendium of information, but rather a progress report on the technical aspects of safety glazing usage in motor vehicles. In accordance with the established policies of the SAE Technical Board, the information in this report will be periodically supplemented and revised to reflect technological progress. It should be noted that this report complements the existing reports, SAE J673, Automotive Glazing and SAE J674, Safety Glazing Materials. See page 11.

HISTORICAL BACKGROUND

The SAE Automotive Glazing Materials and Standards Subcommittee is a subcommittee of the SAE Body Engineering Committee. This subcommittee originated as an SAE

Safety Glazing Advisory Committee, was established shortly after World War I. It was created as a technical committee under what was then known as the SAE Passenger Car Division.

In 1923 this Safety Glazing Advisory Committee issued the first version of the SAE Recommended Practice for Glazing Glass which was a forerunner of the American Standards Association Safety Glazing Code. The Committee worked in close cooperation with an ASA Sectional Committee in developing the ASA Tentative Standard Z26.1 - 1935, The American Standard Safety Code for Safety Glass for Glazing Motor Vehicles Operating on Land Highways. This code was released as a full ASA Standard on March 7, 1938. The SAE also took an active part in subsequent reviews of the code now known as The American Standard Safety Code for Safety Glazing Materials for Glazing Motor Vehicles Operating on Land Highways, Z26.1 - 1950, in 1948, 1950 and 1960.

In 1945, when the then designated SAE Passenger Car Body Division was organized, the glazing committee was redesignated as the Subcommittee on Door and Window Glass. Assignments included the development of typical commercial tolerance information for laminated safety plate and sheet glass, heat treated safety plate and sheet glass, and polished wire glass. This committee activity culminated in the issuance, in 1950, of SAE J673, Automotive Glazing, in the SAE Handbook.

In 1956, the present SAE Body Engineering Committee reorganized the Door and Window Glass Subcommittee, which now operates under the more appropriate designation - Automotive Glazing Materials and Standards Subcommittee. As part of this activity, the subcommittee established specialized subgroups to consider various aspects of motor vehicle glazing and usage.

The material in this report was developed by these specialized subgroups.

CHAPTER 1 - GENERAL CHARACTERISTICS OF SAFETY GLASS

1.1 DEFINITION

The term "safety glass" means safety glazing materials predominantly ceramic in character, so constructed, treated, or combined with other materials as to reduce, in comparison with ordinary sheet glass or plate glass, the likelihood of injury to persons by objects from exterior sources or by these safety glazing materials when they may be cracked or broken.

1.2 TYPES AND APPLICATIONS

1.2.1 Plate Glass - Ordinary plate glass (used to fabricate safety glass) is annealed glass from which surface irregularities have been removed by grinding and polishing, so that the surfaces are approximately plane and parallel. Iron runners and various grades of sand are generally used in grinding, and felt polishing pads and rouge in polishing.

1.2.2 Sheet Glass - Ordinary sheet glass (used to fabricate safety glass) is drawn up directly into a flat sheet from a bath of molten glass to the thickness desired. It is not ground and polished, and its glossy fire-finish surfaces are obtained during the drawing process.

1.2.3 Float Glass - Ordinary float glass (used to fabricate safety glass) is made by floating a continuous ribbon of glass on a bath of molten metal, so that the glass surfaces are approximately plane and parallel. Float glass is not ground. However, a polishing procedure may be used to clean the lower face of glass which has been in contact with the molten metal bath.

1.2.4 Laminated Safety Glass - This consists of two or more sheets of glass held together by intervening layer, or layers, of plastic material. It will crack and break under sufficient impact, but the pieces of glass tend to adhere to the plastic and not to fly. If a hole is produced, the edges are likely to be less jagged than would be the case with ordinary glass. Laminated glass which meets the prescribed test of the ASA Safety Glazing Code Z26.1-1950 may be used throughout the motor vehicle, but when used for windshields, the laminated glass may not produce more than a specified amount of distortion of vision.

One typical process for the manufacture of laminated safety glass involves the assembly of a sheet of plastic (currently a plasticized polyvinyl butyral) between two pieces of flat or curved glass, subjecting the glass-plastic assembly or sandwich to a preliminary heating and pressing action to expel noncondensable gases such as air, and to provide sufficient adhesion between the glass plastic layers to seal the edges and permit handling as a unit. The partially bonded assembly is then placed in an autoclave where the glass-plastic layers are firmly bonded by the further application of heat and pressure.

1.2.5 Heat Treated Safety Glass - (Other terms such as "solid tempered," "tempered glass," "heat toughened glass," "heat strengthened glass," "case hardened glass" are interchangeable.) This consists of a single sheet of specially

heat treated glass. When broken at any point, the entire piece immediately breaks into innumerable small pieces, which may be described as granular, usually with no jagged edges. Under the existing ASA Safety Glazing Code Z26.1-1950 monolithic, heat treated safety glass may be used for all motor vehicle glazing except windshields.

A typical process for the manufacture of heat treated safety glass involves heating a single piece of solid glass (plate, float, or sheet) to a temperature near its softening point and then rapidly cooling its surfaces with air to produce increased strength, and safety fracture characteristics, with balanced strains - compressive in the surfaces and tensile in the center plane. With its surfaces under compression, heat treated safety glass can withstand considerable bending before the outside surfaces exceed their maximum tensional fiber stress - the condition under which glass normally breaks - and therefore has higher resistance to most types of impact. After the tempering process, this safety glass cannot be cut, drilled, or ground.

1.2.6 Chemically Tempered Safety Glass - Consists of a single thickness of sheet or plate glass of special composition which has been chemically treated, usually by immersion in a molten salt bath, to produce increased strength and safety fracture characteristics. When broken at any point, the entire piece immediately breaks into innumerable small pieces, which may be described as granular, usually with no jagged edges. The properties of chemically tempered safety glass are similar to those of heat treated safety glass in that both have balanced strains - compressive in the surfaces and tensile in the center plane. The surface compression permits the safety glass to withstand considerable bending before the outside surfaces exceed their maximum tensional fiber stress - the condition under which glass normally breaks - and therefore has higher resistance to most types of impact. After tempering, this safety glass cannot be cut, drilled, or ground. Under the ASA Safety Glazing Code Z26.1-1950, monolithic, chemically tempered safety glass may be used for all motor vehicle glazing except windshields.

1.2.7 Wire Safety Glass - Consists of a single sheet of glass with meshed wire completely imbedded in the glass, but not necessarily in the center of the sheet. Wire safety glass is used principally in buildings because the wire mesh increases its fire resistance rating.

1.2.8 Marking - Regulations in many states require approval of safety glazing materials. The requirement of ASA Code for Safety Glazing Materials Z26.1-1950 as amended reads as follows:

"In addition to any other markings required by law, ordinance or regulation, all safety glazing materials manufactured for use in accordance with this Code shall be legibly and permanently marked in letters and numerals at least 0.070 in. in height, with the words 'American Standard' or the characters 'AS' and, in addition, with a model number which will identify the type of construction of the glazing