SAE International

SURFACE VEHICLE INFORMATION REPORT

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Steel Products for Rollover Protective Structures (ROPS) and Falling Object Protective Structures (FOPS)

RATIONALE

Document is needed for historical reference. No changes have been made since 1980.

STABILIZED NOTICE

This document has been declared "Stabilized" by the SAE OPTC4, Protective Structures Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

1. ***Scope***—The purpose of this SAE Information Report is to provide concepts for rational selection and application of materials for Rollover Protective Structures (ROPS) and Falling Object Protective Structures (FOPS) and to provide information about the properties that should be considered in selecting and utilizing material in protective structures. While other materials could conceivably be used successfully, this report is limited to a consideration of steel with discussion on its mechanical properties and processing characteristics. Emphasis is placed on the toughness aspect (ability to resist brittle fracture) as this property is of paramount importance to structure integrity. It is emphasized that specific values for material properties have relevance to performance only in conjunction with specific design considerations such as structure size or weld joint detail and location. Because there are many design-material systems which can be successfully employed to achieve the prescribed performance of protective structures, this report does not make categorical selection of steels.

2. *References*

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated, the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J435 JUL74—Automotive Steel Castings
SAE J1392—Steel, High Strength, Hot Rolled Sheet and Strip, Cold Rolled Sheet, and Coated Sheet

2.1.2 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM A 27—Mild- to Medium-Strength Carbon-Steel Castings for General Application
ASTM A 36—Structural Steel
ASTM A 338 (1977)—Melleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service at Temperatures up to 650°F (345°C)
ASTM A 572—High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
ASTM A 607—Steel Sheet and Strip, Hot-Rolled and Cold-Rolled, High-Strength, Low-Alloy Columbium and/or Vanadium

ASTM E 23 (1978)—Notched Bar Impact of Metallic Materials
ASTM E 208 (1975)—Conducting Drop-Weight Test to Determine Nil-Ductility Transition Temperature of Ferritic Steels
ASTM E 399—Test for Plane-Strain Fracture Toughness of Metallic materials
ASTM E 604—Test for Dynamic Tear Energy of Metallic Materials

3. Design-Materials Interface—When assessing the needs for specific values of engineering properties, it should be kept in mind that material properties need not necessarily be the same throughout the structure. A preferred design would be to size sections so that selected areas absorb most of the energy absorbed by the structure during a rollover. Then the material specifications and manufacturing procedures can be selected to match the design and service requirements of the different parts. In other words, some sections of a ROPS or FOPS should use materials with higher toughness levels whereas other sections are designed to be stressed low enough such that fracture or collapse of the structure would not be influenced by this property. It is therefore desirable to identify the highly stressed and high energy absorption areas in the structure during a rollover so that these areas receive the control and inspection of both the materials properties and fabrication procedures they deserve to insure the integrity of the structure. Plastic hinges (location designed to deform plastically and thereby absorb energy—see Figure 1) are examples where close control and inspection should be exercised. The choice of the balance between the design configurations and the selections of materials must be reserved for the manufacturer since it may be preferable to emphasize one aspect over another. These choices will depend upon several variables such as manufacturing capabilities and the volume of the manufactured units.

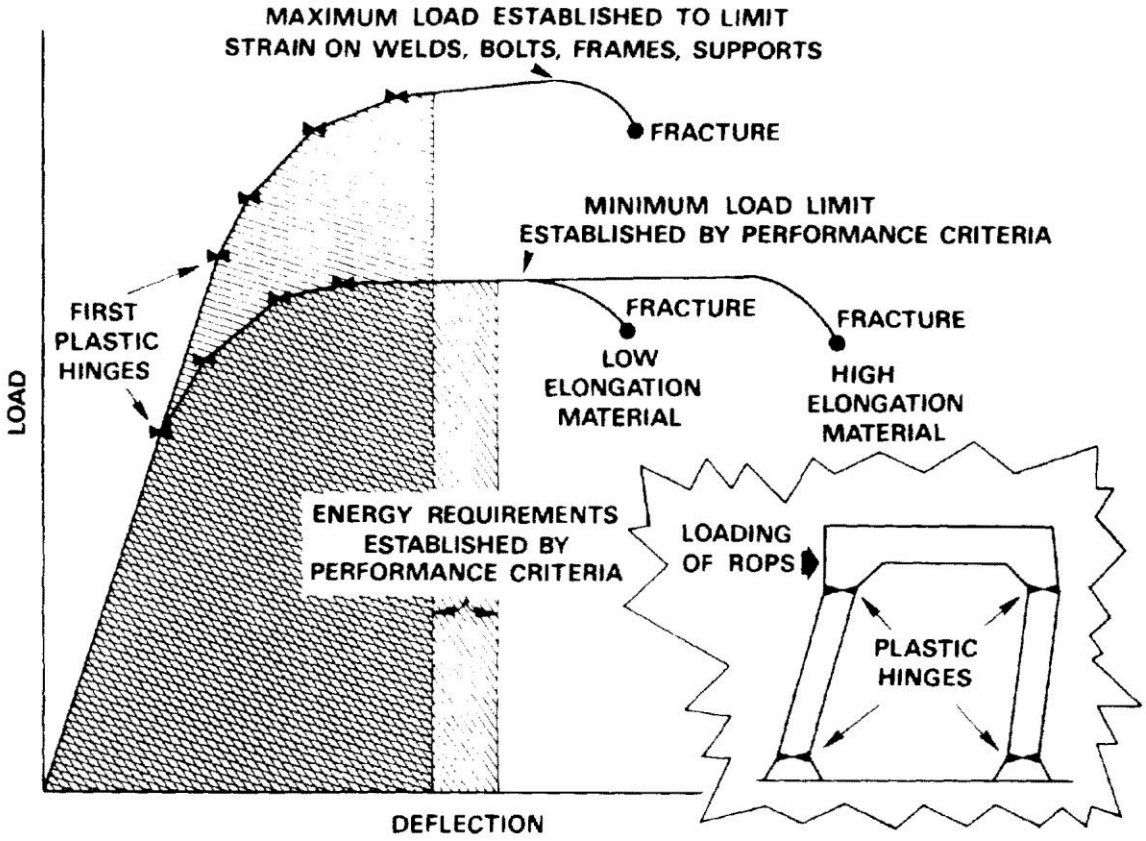

FIGURE 1—LOAD/ENERGY CHARACTERISTICS OF PROTECTIVE STRUCTURES