



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS E 7106 : 2006

(JARI/JSA)

**Rolling stock—General requirements of
carbody structures for passenger car**

ICS 45.060;45.060.01

Reference number : JIS E 7106 : 2006 (E)

PROTECTED BY COPYRIGHT

Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Land, Infrastructure and Transport through deliberations at the Japanese Industrial Standards Committee according to the proposal of establishing a Japanese Industrial Standard from Japan Association of Rolling Stock Industries (JARI)/ Japanese Standards Association (JSA) with a draft of Industrial Standard based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

Date of Establishment: 2006-02-06

Date of Public Notice in Official Gazette: 2006-02-06

Investigated by: Japanese Industrial Standards Committee
Standards Board

Technical Committee on Railways and Rolling Stock

JIS E 7106 : 2006, First English edition published in 2011-02

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

© JSA 2011

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Printed in Japan

PROTECTED BY COPYRIGHT

Contents

	Page
Introduction	1
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Verification of conformity with requirements	3
4.1 General	3
4.2 Uncertainty of loading conditions	4
4.3 Verification of strength	4
4.4 Confirmation of rigidity	4
4.5 Verification of fatigue strength	5
5 Design load	5
5.1 General	5
5.2 Forward and backward load	5
5.3 Vertical load working on carbody	6
5.4 Superposition of static loads working on carbody	6
5.5 Load to apparatus attaching position	7
5.6 Fatigue load of carbody structure	7
5.7 Fatigue load working on boundary portion	8
5.8 Superposition of fatigue load	8
6 Allowable stress of materials to be used	8
7 Load test	9
7.1 Purpose	9
7.2 Static load test	9
7.3 Fatigue strength test	9
Annex 1 (normative) Allowable stress of ordinary steel	11
Annex 2 (normative) Allowable stress of stainless steel	13
Annex 3 (normative) Allowable stress of aluminium alloy	15
Annex 4 (informative) Calculation methods for equivalent bending rigidity and equivalent torsional rigidity	17

Rolling stock – General requirements of carbody structures for passenger car

Introduction The structural design of carbody structures for passenger car of rolling stock varies depending on load conditions and characteristics of materials to be used.

This Japanese Industrial Standard specifies typical criteria which shall be taken into consideration in the structural design of carbody structures for passenger car with respect to load conditions, combination of loads and characteristics of materials to be used.

1 Scope This Standard specifies the load which carbody structures mainly for passenger car such as electric railcars, internal combustion railcars and passenger cars shall withstand, and also specifies the typical strength evaluation method when the structural design is performed by taking into consideration the stress generated by the load on the carbody structures as well as characteristics of materials to be used.

The load conditions specified in this Standard are based on the past experiences over years and the experimental data; however, the load conditions applied to the structural design shall be agreed between the purchaser and the supplier because the load conditions may vary depending on the car operating plan.

NOTE : This Standard is not applicable to the carbody structures of rolling stock for specified railways such as trolley buses with rubber tyres, etc., monorail cars, intermediate capacity transit system cars and magnetic levitation cars. However, this Standard is applicable to the way of thinking of loads working on the carbody structures of such cars as well as the allowable stress of materials to be used for the carbody structures.

2 Normative references The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS E 4001 *Railway rolling stock — Vocabulary*

JIS E 4031 *Railway rolling stock parts — Test methods for vibration*

JIS E 4041 *General rules for the test methods of electric railcar on completion of construction*

JIS E 4043 *General rules for the test methods of diesel railcar on completion of construction*

JIS E 4046 *General rules for the inspection of passenger car on completion of con-*

struction

JIS E 4207 *Truck frames for railway rolling stock — General rules for design*

JIS E 7105 *Rolling stock — Test methods of static load for body structures*

JIS G 3101 *Rolled steels for general structure*

JIS G 3106 *Rolled steels for welded structure*

JIS G 3114 *Hot-rolled atmospheric corrosion resisting steels for welded structure*

JIS G 4305 *Cold-rolled stainless steel plate, sheet and strip*

JIS H 4000 *Aluminium and aluminium alloy sheets, strips and plates*

JIS H 4100 *Aluminium and aluminium alloy extruded shape*

JIS H 4140 *Aluminium and aluminium alloy forgings*

3 Terms and definitions For the purpose of this Standard, the definitions given in JIS E 4001 and the following definitions apply.

- a) **carbody structure** main structure constituting a carbody which is supported by running gears (trucks)

NOTE : A carbody structure has a role of securing safety of the carbody, passengers and crew members during operation of the car. Structural elements which directly affect the strength and rigidity of the carbody structure when attached to the carbody structure are also included.

- b) **purchasing party and designing/manufacturing party**

- 1) **purchasing party** organization responsible for determining technical conditions for cars so that the car can be used according to the operating plan
- 2) **designing/manufacturing party** organization responsible for designing and manufacturing cars so as to satisfy the requirements of the purchasing party

- c) **car type** car types are classified according to the structural conditions of the carbody

In this Standard, cars are classified into the following four types according to the structural features and usage thereof.

- 1) passenger car
- 2) Shinkansen train electric railcar
- 3) electric railcar
- 4) internal combustion railcar

- d) **mass of car**

- 1) **mass of car in working order state (m_1)** mass of a carbody completely built with all on-board parts

NOTE : m_1 includes water, sand, fuel, etc. in their maximum capacity, but does not include mass of crew members.

Information : The minimum loading conditions of “water, sand, fuel and crew members” specified in **JIS E 4041** and **JIS E 4043** as well as “empty car conditions” specified in **JIS E 4046** differ from the working order state in this Standard.

- 2) **maximum mass of loaded car** (m_2) sum of mass of crew members, mass ⁽²⁾ of the number of sitting and standing passengers ⁽¹⁾, mass of baggage ⁽³⁾ in a baggage area and others determined by the car structure and operating conditions.

Notes ⁽¹⁾ Calculation examples of the maximum number of standing passengers shall be as follows.

- a) A value obtained by dividing the floor area capable of securing an effective width of 300 mm or more and an effective height of 1 800 mm or more in the passenger room floor area excluding an area of 100 mm in width from the front end of the seat by 0.1 m²
- b) For the car to which the standing passenger capacity is not given, 0.1 m² above shall be replaced with 0.2 m².
- ⁽²⁾ The mass of a passenger and a crew member shall be 55 kg. If a different mass is designated, it shall be agreed between the purchaser and supplier.
- ⁽³⁾ There is an example that the mass of baggage in a baggage area is deemed as 300 kg/m².

NOTE : The maximum mass of loaded car shall be agreed between the purchaser and supplier in consideration of the car operating conditions.

- 3) **mass of trucks** (m_3) mass of all bottom structures including carbody suspensions (secondary suspension)

NOTE : The mass of joint elements (e.g. centre pins) between the carbody and the trucks shall be assigned to either m_1 or m_3 .

- e) **airtightness load** load due to internal pressure (positive pressure) or external pressure (negative pressure) working on a carbody structure as a result of pressure difference between the inside and outside of the carbody caused by a change in the outside air pressure when a car leaves or enters a tunnel or runs inside of the tunnel

4. Verification of conformity with requirements

4.1 General The carbody structures of rolling stock shall withstand regular service conditions under the maximum load of operating conditions determined for the car.

Using the calculation or testing, the designing/manufacturing party shall verify that the carbody structures will not cause any permanent deformation or destruction under the agreed maximum load. Strength evaluation of a carbody structure shall be performed based on the following criteria.

- a) The carbody structures shall withstand the load determined as the maximum load and shall maintain the service conditions thereafter.
- b) The carbody rigidity should be maintained in such a level that the riding quality is not significantly deteriorated due to the resonance on the completed car during its operation caused by an external force.
- c) The car shall be capable of operating for a specified period of time ⁽⁴⁾ without causing any fatigue failure against ordinary loads or repeated loads.

Note ⁽⁴⁾ These requirements shall be agreed between the purchaser and the supplier.

- d) A designing/manufacturing party shall verify that the design satisfies such loading conditions as agreed with a purchasing party. Load conditions used as a basis of carbody designing shall include the load conditions for each car against the design load as specified in clause 5.

4.2 Uncertainty of loading conditions All load conditions used as a basis of carbody structure designing shall contain a certain degree of allowance against uncertainty in the values. The load values specified in clause 5 contain such allowance.

4.3 Verification of strength Using the calculation or testing, a designing/manufacturing party shall show the whole or respective elements of the structure are free from harmful permanent deformation or destruction under the load conditions specified in clause 5.

- a) **Yield point or proof stress** When design strength is confirmed only by the calculation, safety factors (yield point or proof stress/calculated stress of material) shall be taken into consideration. The allowable stress in consideration of safety factors of materials generally used for carbody structures shall be in accordance with clause 6. However, a material is judged so as to have required strength if the actually measured stresses under the test conditions specified in 5.1 to 5.5 or the combined stresses thereof do not exceed the yield point or proof stress.
- b) **Tensile strength** There shall be safety allowance between the maximum design load and the destruction load. The ratio between the stress caused under the loading conditions of 4.1 and the tensile strength of material, namely the magnitude of safety allowance, shall be agreed between the purchaser and the supplier.

4.4 Confirmation of rigidity Carbody rigidity is an issue of a completed carbody after the completion of assembling. A designing/manufacturing party should figure out the rigidity of carbody structures by calculation. When evaluating the rigidity of carbody structures with actually measured values, equivalent bending rigidity and equivalent torsional rigidity shall be calculated using the applied load and the maximum deformation of carbody structures observed in the vertical load test and the torsional load test, respectively, specified in JIS E 7105. The calculation method of rigidity of this case shall be in accordance with Annex 4.

When measuring the natural bending frequency and natural torsional frequency of a completed carbody, the measurement methods thereof shall be agreed between the