

Test Code of Seating Comfort for Automobile Suspension Seats

1. Scope

This standard prescribes the test methods for evaluating the general performance of automobile suspension seats on their seating comfortability.

Remark: In this standard, units and numerical values given in { } are based on the International System of Units (SI), and are given for reference.

2. Purpose

This standard is developed for standardizing the test methods to be used for testing the seating comfortability of automobile suspension seats and for ensuring an adequate evaluation of the seating comfortability of these suspension seats.

3. Definitions

Definitions of principal terms used in this standard shall be pursuant to **JASO Z 215** (Glossary of Terms Relating to Seats of Automobiles).

4. Kinds of Tests and Their Applicability

4.1 Kinds of Tests

Kinds of the tests shall be classified as shown in **Table 1** according to the objectives of the tests and the characteristics of the test piece to be tested.

4.2 Test Applicability

The test shall respectively be applicable as shown in **Table 2** according to the kinds of the test piece to be tested.

Table 1 Kinds of Tests

Kind of test	Test objective	Characteristics to examine
Load Test	Deflecting performance	Load-deflection curve
		Deflection
		Static spring constant
	Damping performance	Hysteresis loss coefficient
Hardness Distribution Test	Hardness distribution	Hardness distribution curve
Surface Hardness Test	Softness	Load-sinkage curve
		Sinkage
		Static spring constant
Vibration Test	Vibration performance	Acceleration transmissibility characteristics or displacement transmissibility characteristics
		Resonance frequency
		Resonance magnification
		Dynamic spring constant
Damping Test	Damping performance	Damping waveform
		Logarithmic decrement

Table 2 Test Applicability

Kind of the test piece Kind of test	Suspension seat	Seat suspension device	Seat cushion	Seat back
Load Test	○	○	○	○
Hardness Distribution Test	—	—	○	○
Surface Hardness Test	—	—	○	○
Vibration Test	○	○	○	—
Damping Test	○	—	○	—

Remark: ○ Test applicable

Reference Standards:	JIS D 4607-1977	Three Dimensional Manikins for Use in Defining Automobile Seating Accommodations (3DM-JM50)
	JIS Z 8401-1961	Rules for Rounding Off of Numerical Values
	JASO B 407-1982	Test Code of Seating Comfort for Automobile Seats
	JASO Z 009-82	Hip Point of Automobile Seat
	JASO Z 215-77	Glossary of Terms Relating to Seats of Automobiles
	ISO 6549-1980	Road Vehicles — Procedure for H-point Determination

5. General Test Conditions

5.1 Pre-Test Adjustment of Seat Adjustment Devices

Adjust the seat adjustment devices, including the adjustment device for the body weight, to their standard designed positions, recording these adjusted positions.

5.2 Pressing Plates

Pressing plates to be used in the tests shall be as follows.

5.2.1 Kinds of Pressing Plates

Pressing plates shall be of four kinds as shown in Fig. 1. They shall have sufficient strength and rigid body with smooth surfaces well to meet the testing requirements.

5.2.2 Mounting of Pressing Plates onto Tester

Unless otherwise specified, the mounting portions of the pressing plates shall be attached onto the tester by means of the universal joints to be provided therebetween with an exceptional case where column-type pressing plate is used which shall be attached directly.

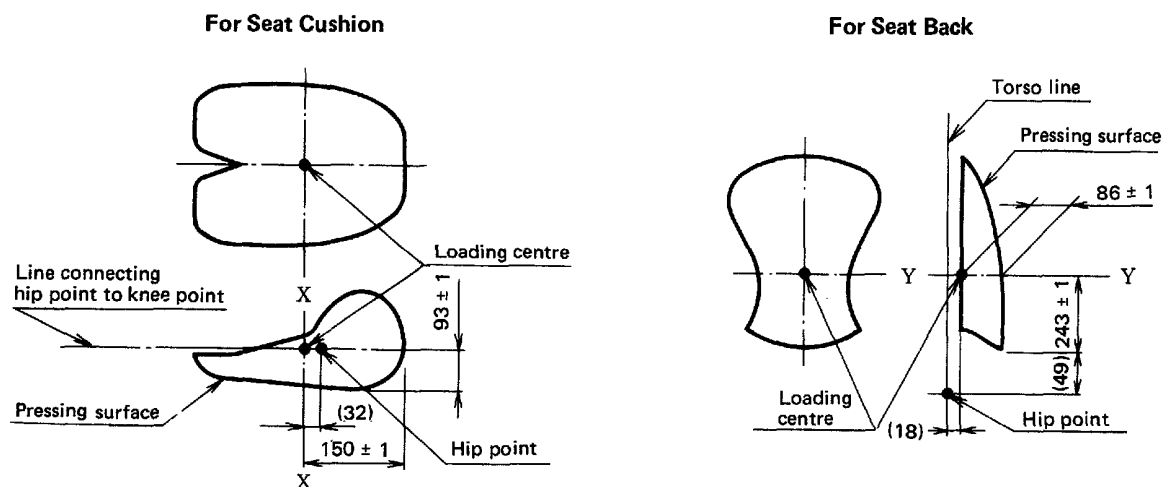
5.2.3 Loading Center of Pressing Plates

Loading center of the pressing plate shall be at the center of the universal joint.

Fig. 1 Pressing Plates

Fig. 1-1 JM Type

Unit: mm



- Remarks**
- 1: Configuration of the pressing plates shall be pursuant to Seat Pan or Back Pan specified in JIS D 4607-1977 [Three Dimensional Manikins (3DM-JM50) for Use in Defining Automobile Seating Accommodations].
 - 2: Center of gravity of the pressing plate shall be on the line X-X or Y-Y.
 - 3: Numerals in parenthesis shown in the Figures are for reference. They indicate the distance from the hip point or the torso line to the pressing plate respectively.

5.3 Applicability and Setting Directions of Pressing Plates

Applicability and setting directions of the pressing plates to be used in the tests shall be as follows.

5.3.1 Applicability of Pressing Plates

The pressing plates shall be applied to the tests as shown in **Table 3** according to the kinds of the test pieces to be tested and the kinds of the tests to be conducted.

Table 3 Application of Pressing Plates

Kind of test \ Kind of the test piece	Suspension seat	Seat suspension device	Seat cushion	Seat back
Load Test	JM-Type, AM-Type, "Tekken"-Type	Not specified in particular	JM-Type, AM-Type, "Tekken"-Type	JM-Type, AM-Type, "Tekken"-Type
Hardness Distribution Test	—	—	Column-Type	Column-Type
Surface Hardness Test	—	—	Column-Type	Column-Type
Vibration Test	JM-Type, AM-Type, "Tekken"-Type	Not specified in particular	JM-Type, AM-Type, "Tekken"-Type	—
Damping Test	JM-Type, AM-Type, "Tekken"-Type	—	JM-Type, AM-Type, "Tekken"-Type	—

Note: As noted in the Table above, in the case of the load or vibration test for the seat suspension device, any kinds of the pressing plates other than JM-, AM- and "Tekken"-types may be used.

5.3.2 Setting Directions of Pressing Plates

Setting directions of the pressing plates shall be as follows.

- (1) In the case of JM- and AM-types, the pressing plates shall be set according to the seating methods respectively prescribed in **JIS D 4607** [Three Dimensional Manikins for Use in Defining Automobile Seating Accommodations (3DM-JM50)], and **ISO 6549** [Road Vehicles — Procedure for H-point Determination].
- (2) In the case of "Tekken"-type, the pressing plate shall be set with its longer side placed sideways on the seat cushion and with its longer side placed lengthways on the seat back, as a rule.

5.4 Points of Load Application and Loading Directions

Location of the loading points and loading directions shall be determined as specified below with the test piece placed at its standard mounting position originally designed, as a rule. (Refer to **Fig. 2**.)

Hip-point, Knee-point, Torso Line, B-point and the reference lines herein referred to in **Fig. 2** are the points and lines of standard design. If these standard points or lines are not known, they shall be determined by actual measurement.

5.4.1 Location of Loading Points

Location of points of loading onto the test piece shall be as follows according to the type of the pressing plates.

(1) Suspension Seat and Seat Cushion

- (a) In the case of JM- and AM-types, the point on the seating center line of the seat cushion, 32mm shifted toward the knee point from the hip point specified in **JASO Z 009** (Hip Point of Automobile Seat).

- (b) In the case of "Tekken"- and Column-types, the point on the seating center line of the seat cushion, 130mm forward-shifted horizontally from B point shown in **Fig. 2**.

(2) Seat Suspension Device

Not specified in particular. Loading point location, however, shall be recorded.

(3) Seat Back

- (a) In the case of JM-type, the point on the seating center line of the seat back, 292mm upward-shifted in parallel with the torso line, from the hip point specified in **JASO Z 009**.
- (b) In the case of AM-type, the point on the seating center line of the seat back, 302mm upward-shifted in parallel with the torso line, from the hip point specified in **JASO Z 009**.
- (c) In the case of "Tekken"- and Column-types, the point on the seating center line of the seat back, 170mm upward-shifted from B point in parallel with the reference line shown in **Fig. 3** or in parallel with the torso line specified in **JIS D 4607** as shown in **Fig. 2**.

Fig. 2 Where and in what Directions the Load to be Applied

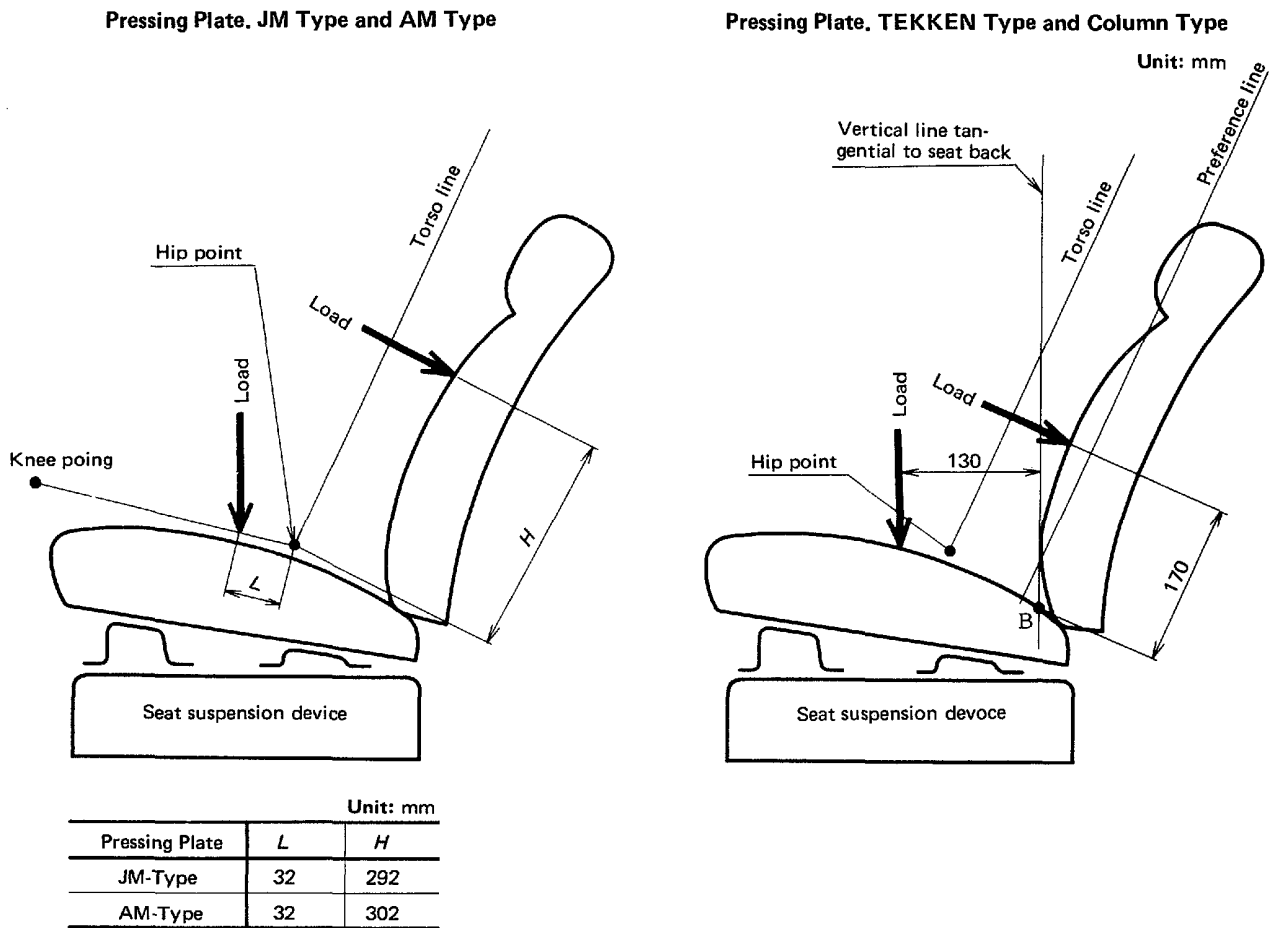
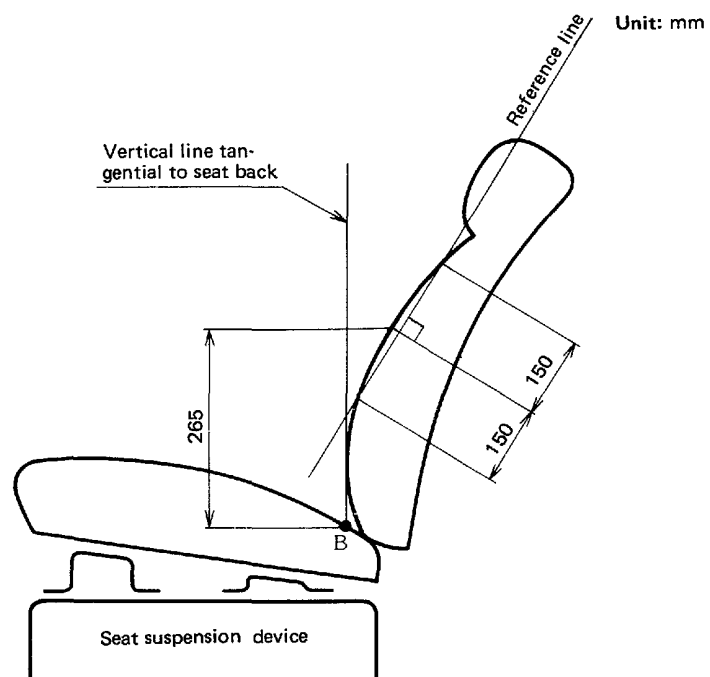


Fig. 3 How to Determine B Point and Reference Line



5.4.2 Loading Directions

Directions of loading to the test pieces shall be as follows.

- (a) For the suspension seat, seat suspension device and seat cushion, to be vertical.
- (b) For the seat back, to be perpendicular to the torso line shown in Fig. 2. As the case may be, the reference line shown in Fig. 3 may be used in place of the torso line.

5.5 Preliminary Pressing

Each test shall be performed after the preliminary pressing has been made onto the loading point specified on the pressing plate at least two times with the test load respectively specified for each test or more load employed. This preliminary pressing, however, may be omitted in such an instance where the test in subsequently made to the test piece to which the load equivalent to this preliminary pressing load has already been given.

5.6 Number of Digits to Indicate Characteristic Values

Number of digits to indicate the characteristic values shall be as shown in Table 4.

Table 4 Number of Digits to Indicate Characteristic Values

Characteristics	Unit	Number of digits to Indicate
Deflection	mm	Integer only
Static Spring Constant	kgf/mm { N/mm }	Down to two places of decimal { Down to one place of decimal }
Coefficient of Hysteresis Loss	%	Integer only
Sinkage	mm	Integer only
Resonance Frequency	Hz	Down to one place of decimal
Resonance Magnification	—	Down to one place of decimal
Dynamic Spring Constant	kgf/mm { N/mm }	Down to two places of decimal { Down to one place of decimal }
Logarithmic Decrement	—	Down to two places of decimal

Remark: Rounding off of the numerals shall be made in accordance with the provisions prescribed in JIS Z 8401 (Rules for Rounding Off of Numerical Values).

6. Test Methods

6.1 Load Test

Load test shall be made as follows.

6.1.1 Mounting of Test Piece onto Tester

The test piece shall be mounted onto the tester so that the loading direction prescribed in 5.4.2 can become vertical. In the case of the seat suspension device which is constructed not to work vertically, however, such a seat suspension device must be set in the state of free moving before testing.

6.1.2 Relative Location of Pressing Plate and Test Piece

The test piece shall be placed so that the vertical line from the loading center of the pressing plate can become in alignment with the loading direction at the loading point on the test piece specified in 5.4.1 and the pressing surfaces of the pressing plate can become mostly in parallel with the surfaces of the test piece on which no load is applied yet.

6.1.3 Test Loads

Test loads shall be as shown in Table 5.

6.1.4 Initial Load and Loading/Unloading Speeds

First, apply the initial load of 0.5kgf {5N} onto the test piece, and, next, with the load center of the pressing plate at that time set as the starting point of further action, apply the load onto the test piece up to the test load respectively specified in Table 5 and release the load therefrom both at the speeds of 150~300mm/min. Develop the load-deflection curve as shown in Fig. 4. Record the loading and unloading speeds at that time. As an exception however, in the case of the seat suspension device, the loading and unloading shall be made with the point where the pressing plate touches the test piece set as the starting point of these actions, instead. The break time for switchover from loading to unloading shall be no longer than 2 seconds.

Fig. 4 Load-Deflection Curve

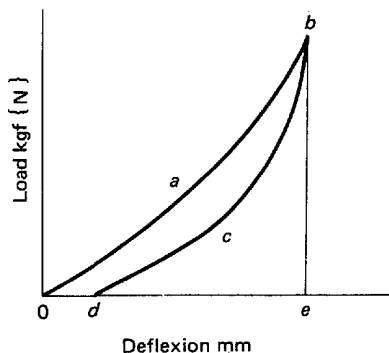


Table 5 Test Loads

Unit: kgf {N}				
Kind of the test piece Kind of Pressing Plate	Suspension seat	Seat suspension device	Seat cushion	Seat back
JM-Type	Maximum Load	Maximum Load	The load equivalent to Mass adjusted by Body Weight Adjusting Device + 20 {200}	41 {400}
AM-Type				51 {500}
"Tekken"-Type				31 {300}

Remark: Maximum Load shown in the table above denotes the load required for pressing down to stop.

6.1.6 Results

Obtain the following values respectively from the load-deflection curve as shown in Fig. 4, examining the deflection and damping performance.

- (1) Deflections shall be the values corresponding to the values at the time when the load shown in Table 6 is applied.
- (2) Static spring constant shall be the value of tangent of the tangential line to the loading-side curve at the time when the load shown in Table 6 is applied.

- (3) For obtaining coefficient of hysteresis loss, first measure the loaded area and the hysteresis loss area, and subsequently obtain it from the following formula.

$$\alpha = \frac{\text{Area } 0abcd}{\text{Area } 0abe}$$

where, α : Coefficient of Hysteresis Loss (%)

Table 6 Loads for Deflection Measurement

Unit: kgf {N}				
Kind of the test piece Kind of Pressing Plate	Suspension seat	Seat suspension device	Seat cushion	Seat back
JM-Type	Load equivalent to mass adjusted by body adjusting device	Load equivalent to mass adjusted by body adjusting device plus load equivalent to mass of the seat	Load equivalent to mass adjusted by body adjusting device	26 {250}
AM-Type				31 {300}
"Tekken"-Type				15 {150}

6.2 Hardness Distribution Test

Hardness distribution test shall be made as follows.

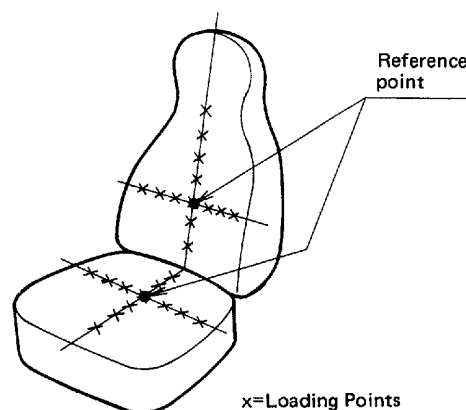
6.2.1 Mounting of Test Piece onto Tester

The test piece shall be mounted on the tester so that the loading direction prescribed in 5.4.2 can become vertical.

6.2.2 Relative Location of Pressing Plate and Test Piece

As shown in Fig. 5, the points where the load is to be set, in sequence respectively, 50mm apart with one another with the points specified in 5.4.1 used as the reference points, on the longitudinal and lateral lines in the case of the seat cushion, and on the longitudinal and vertical lines in the case of the seat back, which are passing through these reference points and running crosswise with each other at right angles on the planes vertical to the loading directions. The loading centers on the pressing plates shall respectively come in alignment with the loading directions at the loading points which have been set. Measurement shall be made at all the loading points lying within the areas where the measurement is possible, as a general rule.

Fig. 5 Location of Loading Points



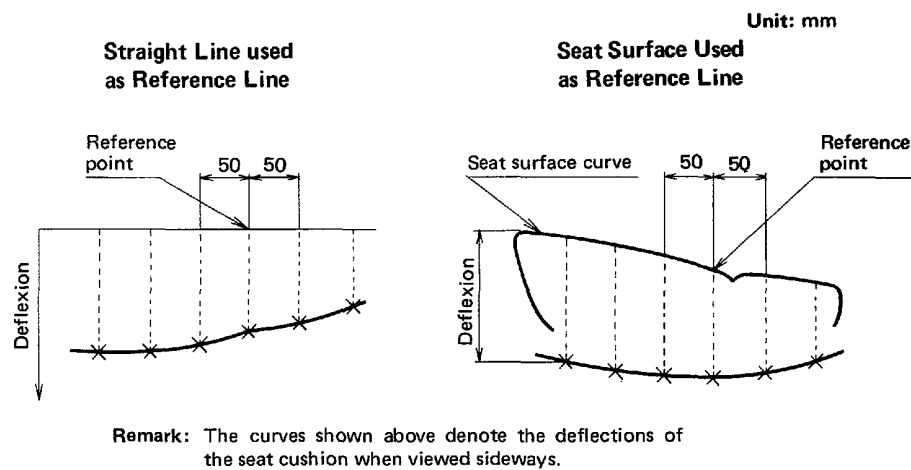
6.2.3 Initial Load, Loading Speed, and Loads When Deflections are Measured

Apply the initial load of 0.5kgf {5N} onto the test piece, and, with the loading center identified at that time on the pressing plate set as the starting point of subsequent loading action, further apply the load onto the seat cushion and onto the seat back at the speed not exceeding 1000/min. The load to be applied shall be not less than 20kgf {200N} in the case of the seat cushion and not less than 10kgf {100N} in the case of the seat back. Measure the deflections when the load of 20kgf is applied to the seat cushion and when the load of 10kgf is applied to the seat back, both.

6.2.4 Results

Develop the hardness distribution curves as shown in Fig. 6 from the deflections identified at the respective loading points, examining the hardness distribution.

Fig. 6 Hardness Distribution Curves (Examples)



6.3 Surface Hardness Test

Surface hardness test shall be made as follows.

6.3.1 Mounting of Test Piece onto Tester

The test piece shall be mounted on the tester so that the loading direction prescribed in 5.4.2 can become vertical.

6.3.2 Relative Location of Pressing Plate and Test Piece

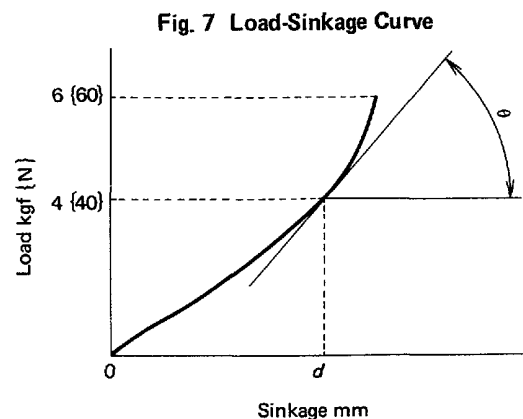
The test piece shall be positioned so that the vertical line from the loading center of the pressing plate comes in alignment with the loading direction at the loading point specified in 5.4.1.

6.3.3 Initial Load and Loading Speed

Apply the initial load of 0.5kgf {5N} onto the test piece, and, with the loading center identified at that time on the pressing plate set as the starting point of subsequent loading action, further apply the load up to 6kgf {60N} at the loading speed of 150~300mm/min. Load-sinkage curve shall be developed as shown in Fig. 7. Loading speed at that time shall be recorded.

6.3.4 Results

Obtain the amount of the sinkage and static spring constant, from the load-sinkage curve as shown in Fig. 7, at the time when the load of 4kgf {40N} is applied, examining the softness. Static spring constant shall be the value of tangent of the angle between the tangent line to the curve and the axis of abscissa at the time when the load of 4kgf {40N} is applied.

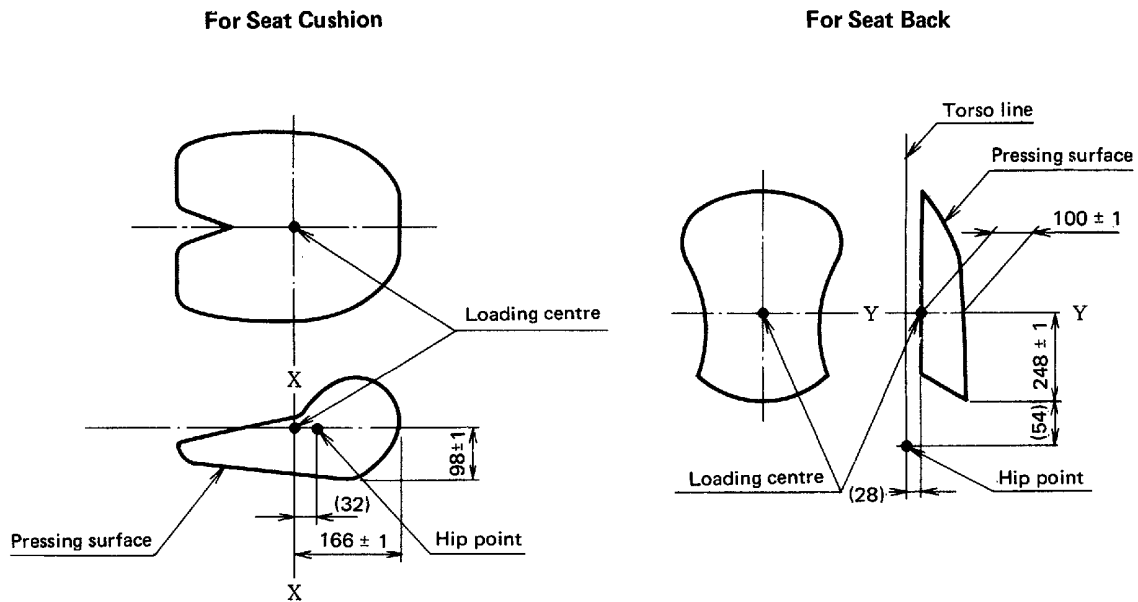


Amount of Sinkage = d (mm)

Static Spring Constant = $\tan \theta$ (kgf/mm {N/mm})

Fig. 1-2 AM Type

Unit: mm

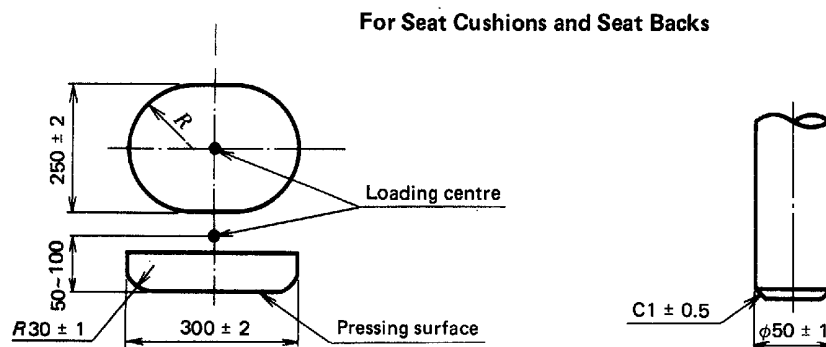


- Remarks**
- 1: Configuration of the pressing plates shall be pursuant to Seat Pan or Back Pan specified in ISO 6549 (Road Vehicles-Procedure for H-point Determination).
 - 2: Center of gravity of the pressing plate shall be on the line X—X or Y—Y.
 - 3: Numerals in parenthesis shown in the Figures are for reference. They indicate the distance from the hip point or the torso line to the pressing plate respectively.

Fig. 1-3 Tekken Type

Fig. 1-4 Column Type

Unit: mm



6.4 Vibration Test

Vibration test shall be made as follows.

6.4.1 Mounting of Test Piece onto Tester

The test piece shall firmly be fixed onto the tester so that the loading direction prescribed in 5.4.2 become vertical.

6.4.2 Relative Location of Pressing Plate and Test Piece, and Mounting of Pressing Plate onto Test Piece

The test piece shall be positioned so that the vertical line from the loading center of the pressing plate comes in alignment with the loading direction at the loading point specified in 5.4.1. In the case of the seat suspension device, however, the pressing plate may directly be mounted onto the test piece, as required.

6.4.3 Mass of Pressing Plate

Mass of the pressing plate shall be equivalent to the load at the time when the deflection is measured which is indicated in Table 6.

6.4.4 Total Amplitude and Frequency

The total vertical amplitude of the shake table shall be selected from among 2, 5, 10, 15 and 20mm. The exciting frequency shall be within the range from 1Hz up to a frequency to exceed the resonance frequency by 2Hz or more. The shaking wave shall be sine wave, as a rule.

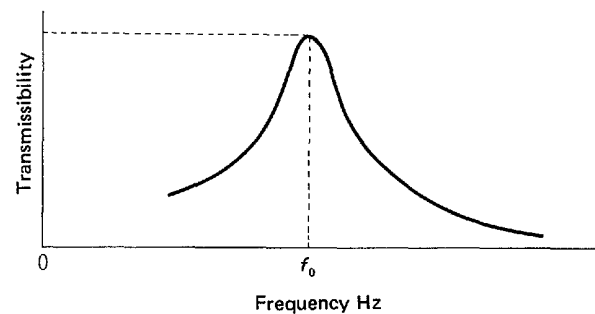
6.4.5 Acceleration and Absolute Displacement Measuring Positions

Measuring positions of acceleration and absolute displacement shall be as close to the loading center of the pressing plate as possible. As an exception, however, in the case of the seat suspension device, any positions arbitrarily selected shall be used.

6.4.6 Results

Develop, from the measurements obtained, the acceleration transmissibility characteristics diagram or the displacement transmissibility characteristics diagram, as shown in Fig. 8, on the relationship between transmissibility⁽¹⁾ and frequency. Obtain, from these respective diagrams, the resonance frequency⁽²⁾ and the resonance magnification⁽³⁾, calculating, from the following formula, the dynamic spring constant for examining the vibration performance.

Fig. 8 Acceleration Transmissibility Characteristics Diagram or Displacement Transmissibility Characteristics Diagram



$$Kd = (2\pi f_0)^2 \frac{W}{G}$$

where, Kd : Dynamic spring constant (kgf/mm) {N/mm}

f_0 : Resonance frequency (Hz)

W : Load (kgf) {N}

G : Acceleration of gravity (9800mm/s²)

Notes (1): In the case of acceleration transmissibility, it denotes the ratio between the acceleration found on the pressing plate and the acceleration found on the shake table. Whereas, in the case of displacement transmissibility, it denotes the ratio between the absolute displacement found on the pressing plate and the total vertical amplitude of the shake table.

(2): The frequency to read at the time when the transmissibility shows its maximum value.

(3): The maximum value of the transmissibility.

6.5 Damping Test

Damping test shall be made as follows.

6.5.1 Mounting of Test Piece onto Tester

The test piece shall firmly be fixed onto the tester so that the loading direction prescribed in 5.4.2 become vertical.

6.5.2 Relative Location of Pressing Plate and Test Piece

The test piece shall be positioned so that the vertical line from the loading center of the pressing plate comes in alignment with the loading direction at the loading point specified in 5.4.1.

6.5.3 Mass of Pressing Plate

Mass of the pressing plate shall be equivalent to the load at the time when the deflection is measured, as indicated in Table 6.

6.5.4 Drop Height and Damping Wave Measuring Position

Raise the pressing plate to any point arbitrarily chosen within the distance up to 50mm high vertically measured from the loading center of the test piece, and have it dropped freely. Record the damping waveform of the point as close to the loading center of the pressing plate as possible as shown in Fig. 9.

6.5.5 Results

Using the damping waveform diagram as shown in Fig. 9, obtain the logarithmic decrement from the following formula for examining the damping performance.

$$\lambda = \log_e \frac{1}{n} \left(\frac{a_0}{a_1} + \frac{a_1}{a_2} + \dots + \frac{a_{n-1}}{a_n} \right)$$

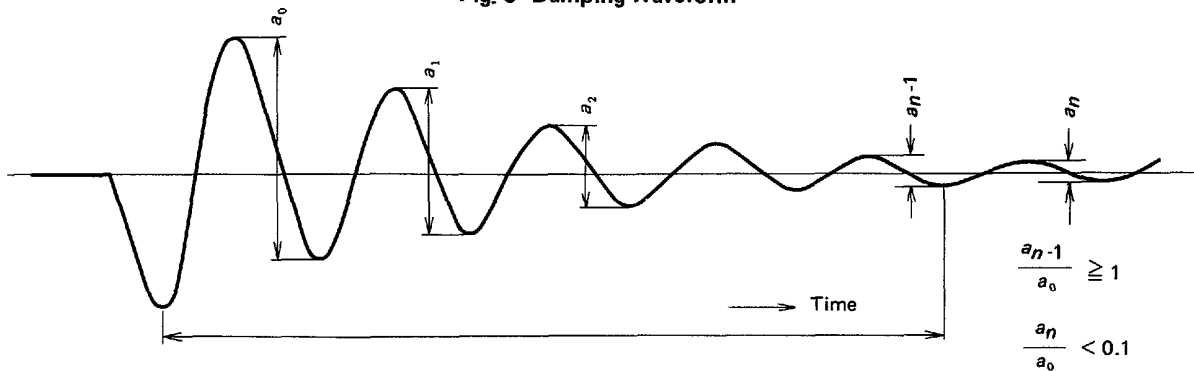
where, λ : Logarithmic decrement

a : Amplitude

n : Number of waves which have been read.

The waves shall be read until the amplitude of the last wave becomes smaller than 10% of the amplitude of the first wave (a_0).

Fig. 9 Damping Waveform



Remark: The waveform shown above denotes the damping waveform caused by the acceleration.

Explanatory Notes
on
JASO B 409-82 Test Code of Seating Comfort for Automobile Suspension Seats

1. Applicability of this Standard

This standard is to be applied to the test methods for evaluating the general performance of automobile suspension seats on their seating comfort. Seating comfort herein referred to is represented by the extent of deflection of the seat cushion and seat back to sustain both in static and in dynamic when seated by the occupant. By ascertaining the extent of such deflection, the seat comfortability and resultant vehicle ride quality can be evaluated.

As referred to above, this standard is for evaluating the general performance of automobile suspension seats on their seating comfort. This standard is, therefore, not applicable to any test of specific type but applicable to the tests which have generally been used.

4. Kinds of the Tests and their Applicability

4.1 Kinds of the Tests

This standard specifies the testing methods to be used. Five kinds of testing methods are established, but the conduct of all these five is not necessarily required, and the sequence of testing of any of these five, when conducted, is not specified in particular.

Selection of the test or tests to be conducted and the sequence of testing when two or more tests are to be conducted can be determined, as required, with the consent of the parties involved, i.e., the product manufacturing side and the product receiving side.

5. General Testing Conditions

5.1 Pre-Test Adjustment of Seat Adjustment Devices

On the suspension seat, there provided several kinds of adjustment devices including the one for the occupant's body weight. Their standard positions originally designed vary depending on the kinds of the test pieces. They are the devices not always engineered according to a uniform design standard. As a result, standardization of their pre-test adjustment methods is considered not possible. We, therefore, have decided that any adjustment device position and that such position is to be recorded.

5.2 Pressing Plate

- (1) As the pressing plate, four types are specified. Of these four, three, i.e., JM-type, AM-type and "Tekken"-type are used for the testing of load, vibration and damping. JM-type is equivalent to JSAE-3DM, and AM-type is equivalent to SAE-3DM; whereas, "Tekken"-type is the one which has been developed by the Railway Technical Research Institute of Japan National Railway Corporation.
- (2) No pressing plate is specified in particular for the seat suspension device. The reason is that most of seat suspension devices are made of steel, and, if any kind of pressing plate specified for the use of others is used for its testing, it is very likely to have it damaged by impact. This is the reason. Any appropriate type of pressing plate such as box-type one, sand bag or the like can be mounted, instead, onto the seat suspension device. Kind of such a pressing plate has to be recorded when used.
- (3) In the case of JM- and AM-type pressing plates, the loading center is determined so that their inclination at the time when the load is applied thereon becomes the same as that to experience when 3DM is seated.

5.4 Points of Loading and Loading Directions

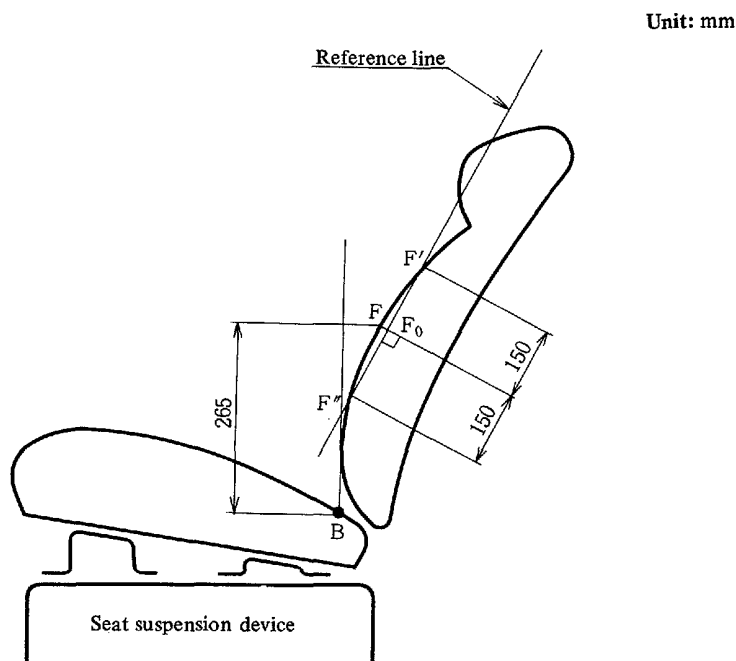
- (1) For the seat cushion, the loading point to be set on "Tekken"-type pressing plate is determined to the point 130mm forward-shifted from B point after consideration was given to the following facts.
 - (a) When a seat with seat back attached is tested, the clearance, at least 125mm, has to be secured between the pressing plate and the seat back so that they can not interfere with each other.
 - (b) On 3DM, the distance from H point to the back of the buttock is 118mm on JM50 and 134mm on AM50.
 - (c) On a human body, the distance from the sciatic tuber to the back of the buttock is 130~140mm.
- (2) For the seat back, the loading point set on "Tekken"-type pressing plate is determined to the point 170mm upward-shifted from B point by the following reason.

On a human body, the distance from the sciatic tuber to the 3rd~4th lumbers (where the seat back is supported) is 230~250mm (or approx. 240mm on an average). The amount of deflection of the seat cushion (or more specifically, the distance from the loading point on the seat cushion to the line running on B point when measured parallel to the reference line) is approx. 70mm on an average. The amount of upward-shifting of the loading point, 170mm, is, therefore, obtained from deducting the 70mm from the 240mm.
- (3) The loading directions are set based on the following facts.
 - (a) In the case of the seat cushion, the load exerted onto the surface of the seat cushion, when seated, works vertical. The direction of loading by the pressing plate is, therefore, set vertical too.
 - (b) In the case of the seat back, the load exerted rearward, when seated, is considered to work as the moment around H point. The direction of loading from the pressing plate is, therefore, set vertical to the torso line.
- (4) B point and the reference line shown in Fig.3 are determined as follows. (Refere to Explanatory Fig. 1)
 - (a) **B Point** Draw the vertical line tangent to the surface of the seat back down from a point on the seating center line of the seat. Next, find the intersection of this tangent line and the surface of the seat cushion. This is B point.
 - (b) **Reference Line** Find the point on the surface of the seat back which is on the seating center line of the seat, 265mm⁽¹⁾ vertically above B point. Define this point as F point. Next, find two other points, F' and F'', on the surface of the seat back so that the respective distances, F_0-F' and F_0-F'' , become 150mm as shown in the figure. The line passing through these two points, F' and F'', is defined as the reference line.

Note: The 265mm⁽¹⁾ cited above is the dimension per SAE. F point is the center of loading onto the seat back.

- (5) The seat suspension device itself is of configuration different with one another, device to device. There also found such a case where the seat suspension device is not positioned vertically under the loading point of the suspension seat. Having these two taken into consideration, the loading point on the seat suspension device has not been specified in particular,

Explanatory Fig. 1 How to Get Point B and Reference Line



6. Test Methods

6.1 Load Test

- (1) In such a case where the seat suspension device to be tested is of construction not to work vertically, the seat suspension device must be set in the state of free moving before testing. This is by the following reason.

In the case of several specific types of seat suspension devices, they are designed not to work vertically but to work in an arc. With this specific mechanism, an extent of surface-to-surface mismatching will develop between the pressing plate and the suspension seat or the seat suspension device when the pressing plate comes down vertically in the case of the suspension seat and seat suspension device mounted on the tester. This results in less accuracy of the load-deflection curve to be developed. This deviation must be adjusted. By keeping the seat suspension device in free moving state, this can be made possible. Providing rollers or something like that under the seat suspension device will be a method to make the seat suspension device movable.

- (2) In JASO B 407, the test load is specified for each pressing plate according to its type. In the case of the suspension seat and seat suspension device, on the contrary, not specified in particular. As mentioned in 5.1 of this Explanatory Note, the standard position of the test piece originally designed varies test piece to test piece. Simple standardization of the test loads is, therefore, not possible in this case.

The suspension strokes vary between test pieces. Extent of deflection of the stopper rubber and the feel of bottoming thereof must also be examined. Considering these two, the load required for pressing the seat suspension device down to stop at the respective standard designed position thereof is determined as the test load to be applied.

As for the test load to be applied onto the seat cushion, it is determined to the load somewhat bigger. The load of 20kgf is added. The pressing onto the pressing plate can not be stopped at the point where the load is to be measured. This is the reason.

- (3) In JASO B 407, the loads to be applied at the time when the deflections are measured are respectively specified by type of pressing plate to use. In the case of testing the suspension seat and the seat suspension device, however, this is not possible. As mentioned in 5.1 of this Explanatory Note, the originally designed standard position of the test piece varies between test pieces. Simple standardization of the loads for the deflection measurement is, therefore, not possible in this case.

In the testing of the seat suspension device, the seat is taken away from the suspension seat. So as to compensate for the loss of weight caused by the seat removal, the load corresponding to the mass of the seat removed is added.

- (4) For ascertaining the static spring constant, the tangent of the tangential line to the load-deflection curve is measured. We can employ another method for that purpose, of course. This is the method to measure the tangent of the line passing through two points on the load-deflection curve — one located on one side of the load measuring point and the other on the other side of the load measuring point. For keeping the measurement error to minimum, however, the adoption of the tangent of the tangential line to the load-deflection curve is considered preferable.
- (5) As for the initial load to be applied, we can say “the smaller the better”. With the initial load extremely small, however, the load-deflection curve can hardly be stable. Considering this fact, 0.5kgf is adopted as the reasonable value of the initial load to be applied. This value has been justified by the experiments so far made with several different kinds of seats.
- (6) Deflections and static spring constants can be measured both on the loading side and on the unloading side of the load-deflection curve. The measurement has usually been made on the loading side of that curve. We adopt this method in this standard.

6.2 Hardness Distribution Test

- (1) In this standard, the load measuring points are set 50mm apart with one another. No particular reason do we have therefor, however. If arranged too wide apart, the measuring points will decrease in number, resulting, however, in less accuracy in the test results. If arranged too close with one another, on the contrary, too much time it takes for measurement with, however, not so much increase in accuracy corresponding thereto in the test results. From the practical testing standpoint, therefore, the interval of 50mm is adopted, which is the same as the diameter of the pressing plate to use.

6.3 Surface Hardness Test

This test is to be made for evaluating, by means of a physical testing, the extent of the softness of the seat surfaces which has so far customarily been evaluated by hand touching. The new test method this time adopted is based on the results of our experiment which tell us that the rating of the subjective evaluation made by hand touching are mostly the same as the results of a physical testing in which the load of approx. 4kgf is applied onto the seat surfaces by using a column-type pressing plate.

6.4 Vibration Test

- (1) Total shaking amplitude can be selected from among 2, 5, 10, 15 and 20mm, as required. In the case of the seat having a big transmissibility, the amplitude of the pressing plate will come up excessively high. For avoiding such an occurrence, an optional selection of the shaking amplitude is made possible from these five in this test. It must be noted, however, that the resonance frequency changes depending on the change in the amplitude, to be more specific, the bigger the amplitude is, the smaller the resonance frequency becomes.
- (2) Position for measuring both acceleration and absolute displacement are set as closer as possible to the loading center of the pressing plate with the exception, however, in the case of the seat suspension device whose measuring positions for those two to be selected arbitrarily. This is so determined because there may happen such a case where the measuring equipment can not be fixed right at the loading center of the pressing plate.
- (3) Exciting frequency is limited within the range of area starting from 1Hz and coming up to the point to exceed the resonance frequency by 2Hz or more. This is because, when the exciting frequency stays at 1Hz or below, the transmissibility remains very close to 1 (where, the resonance frequency of the seat is 2~4Hz or thereabout), and, when the exciting frequency disagrees as much as 2Hz with the resonance frequency, the exciting vibration is mostly kept insulated.

6.5 Damping Test

- (1) In 6.5.4 of JASO B 407, the height from which the pressing plate is dropped is specified as the point 20mm high from the seat surface. In the case of the test to be given to the suspension seat, however, such a height is considered not appropriate because, with that much height used, measurement of the waveform is hardly possible. The pressure plate dropping height is, therefore, changed to any point to be arbitrarily chosen within the distance of 50mm at maximum vertically measured from the seat surface. By so changing, measurement of the waveform becomes easier.
- (2) The characteristics to be ascertained in the damping test are the damping waveform and the logarithmic decrement only. The damping time is not adopted. This is because of a fact that the damping time has not usually been examined in this kind of test and a fact that, even if examined, we have to have too much variations in the measurements obtained. We have judged that the damping performance of the seat can sufficiently be ascertained only by examining the damping waveform and the logarithmic decrement both.

**In the event of any doubt, the original
standards in Japanese should be referred.**

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