مقدمه

تاریخچه ایسوزو:

درسال ۱۹۱۶ شرکت مهندسی وکشتی سازی ISHIKAWAGIM و شرکت صنایع گاز و الکتریک توکیو تصمیم به ساخت مشترک اتومبیل گرفتند. در سال ۱۹۱۸ قرار داد همکاری مشترک فنی باشرکت WOLSELSY انگلستان منعقد گردید ودرسال ۱۹۲۲ اولین وانت تولید شده در ژاپن با نام A-9 معرفی گردید. درسال ۱۹۳۳ شرکت صنایع اتومبیل سازی ISHILAWAJIM باشرکت اتومبیل سازی DOT ادغام وشرکت صنایع اتومبیل AUTOMOBILE INDUSTRIES بوجود آمد. طی نشستی که در سال ۱۹۳۴ باوزیر صنایع و بازرگانی ژاپن برگزار گردید مقرر شد از آن پس نام ایسوزو بر روی محصولات کارخانه گذاشته شود. ایسوزو نام رود خانه ای بود که از پشت معبد مقدس ژاپنی ها می گذشت. در سال ۱۹۳۷ شرکت اتومبیل سازی توکیو که در واقع ایسوزو کنونی است با سرمایه یک میلیون ین به ثبت رسید وپیرو آن در سال ۱۹۴۹ نام شرکت رسماً به ایسوزو تغییر یافت ومیزان سرمایه نیز به ۱۵۰ میلیون ین افزایش یافت در همان سال نیز اولین خودرو ایسوزو به هنگ کنگ صادر شد.

تاریخچه تاسیس گروه بهمن:

گروه بهمن در سال ۱۳۳۱ تحت عنوان «شرکت سهامی ایران خلیج کو» باسرمایه اولیه ۶۰۰ هزار ریال به منظور انجام عملیات حمل ونقل از جمله حمل ونقل دریایی وحق العمل کاری نمایندگی های تجاری تأسیس وشروع به کارنموداین شرکت ازسال ۱۳۳۸ با اخذ مجوز ساخت از سوی وزارت صنایع و معادن اقدام به مونتاژ وانت سه چرخ مزدا با ظرفیت ۲۰۰ کیلوگرم نمود و سپس در سال ۱۳۵۰ با افزایش سرمایه،موضوع فعالیت خود را به ساخت و مونتاژ انواع وانت های مزدا تبدیل کرد و وانت مزدا ۱۰۰۰CC با ظرفیت ۵۰۰ کیلو گرم را به مرحله تولید رسانید . در این سال نام رکت به کارخانجات اتومبیل سازی مزدا تغییر یافت . بعد از ان در سال ۱۳۶۳ وانت مزدا ۱۶۰۰CC نیز به انواع تولیدات اضافه و نام شرکت به ایران وانت تبدیل گردید . در سالهای تولید ۶۶-۶۵ ،شرکت به مونتاژ وانت مزدا۱۸۰۰CC پرداخت و از اواخر سال ۱۳۷۲ در پی واگذاری سهام به بخش خصوصی ، دگرگونی قابل ملاحظه ای در روند فعالیت های شرکت بوجود امد ، بطوری که موضوع فعالیت شرکت به تولید و بهره برداری ، طراحی و ساخت خودرو وانت دو کابین ۲۰۰۰CC و آمبولانس ۱۶۰۰CC تغییر داده شد.

در مورخ ۱۳۷۸/۴/۲۸ و بر اساس مصوبه مجمع عمومی فوق العاده صاحبان سهام وبا تغییر اساسنامه، نقطه عطف حیات شرکت در زمین های مختلف از جمله تولید انواع سواری مزدا ۳۲۳F ، ۳۲۳GLX ، ۳۲۳FL، خودرودنده اتوماتیک ، تولید انواع شاسی و شاسی قابل

حرکت ، تولید قطعات ریخته گری ، تولید انواع موتور سیکلت و دوچرخه و انجام فعالیت های بازرگانی و سرمایه گذاری در دستور کار قرار گرفت .

به عنوان اولین شرکت خودرو ساز در سال ۱۳۷۹ لوح صنعت سبز را از سازمان حفاظت محیط زیست دریافت نمود و در سال ۱۳۸۲ به عنوان اولین شرکت خودرو ساز، موفق به دریافت گواهینامه IMS گردید که شامل استاندارد های زیر میباشد :

I. ISO14001
II. OHSAS18001
III. ISO 9001-2000
IV. ISO/TS:2002

مختصری در مورد مرکز بهمن دیزل:

این شرکت در تاریخ ۱۳۸۲/۱۱/۰۸به صورت شرکت سهام عام تاسیس گردید و تحت شماره ۲۱۵۸۳۴۵به ثبت رسیده است موضوع شرکت اشتغال به کلیه فعالیت های تولیدی و صنعتی نظیر مونتاژ انواع خودرو و وسایل نقلیه موتوری و دیزلی و سبک و سنگین و انواع کامیون، اتوبوس ، کامیونت و تریلر به منظور نوسازی ناوگان حمل ونقل داخلی کشور، اقدام به هر گونه مشارکت با اشخاص حقیقی و حقوقی داخلی و خارجی، تأسیس هر نوع شرکت، مؤسسه مالی و اعتباری با رعایت مقررات مربوطه ، خرید و فروش سهام سایر شرکتها و مؤسسات ، ارائه هر گونه خدمات اعم از فنی و مهندسی نظیر ساخت ماشین الات صنعتی ، ساخت قطعات مورد نیاز صنایع مختلف و توزیع انها ، شرکت در مناقضه و مزایده ها و حضور در نمایشگاه های داخلی و خارجی دولتی و غیر دولتی می باشد .

گروه بهمن به منظور افزایش تنوع محصولات خود وحضور دربازار خودروهای سنگین دیزلی وتجاری با رعایت آخرین استاندارد های زیست محیطی تاسیس گردید وپس ازانجام بررسیهای کارشناسی شرکت ایسوزوی ژاپن را برای همکاری ،جهت تولید کامیونت ،کامیون وخودروهائی با سوخت دیزلی انتخاب کرد و در اولین مرحله ، تولید کامیونت ۶ تن NPR در برنامه کاری گروه بهمن قرار گرفت وبا تشکیل تیم های کار شناسی و فنی طی یک برنامه ریزی دقیق توانست در طول ۹ ماه از خرداد ، لغایت بهمن ۱۳۸۲ خط تولید کامیونت ایسوزو را با ظرفیت ۱۰ دستگا ه در روز طراحی ، اجرا و آماده بهره برداری نماید و در ۱۹ اسفند ماه همان سال بدست وزیر صنایع وقت ، رسماً افتتاح گردید و گروه بهمن نیز به جمع شرکتها ی تولید کننده خودرو های دیزلی پیوست. شرکت بهمن دیزل بعد از تولید موفقیت آمیز کامیونت ۶ تن ، طی مطالعات صورت گرفته وبا تجارب کسب شده با همکاری کادرکارشناسی وفنی ، تولید کامیون ۸ تن، مدل NQR را در سال ۱۳۸۴ آغاز نمود وبعد از آن در سال ۱۳۸۵ نیز اقدام به تولید کامیونت سبک NKR با وزن ناخالص ۵/۲ تن در استان قزوین نمود و در مدت زمانی اندک توانست سهم قابل قبولی از بازار خودروهای نیمه سنگین را به خود اختصاص دهد.

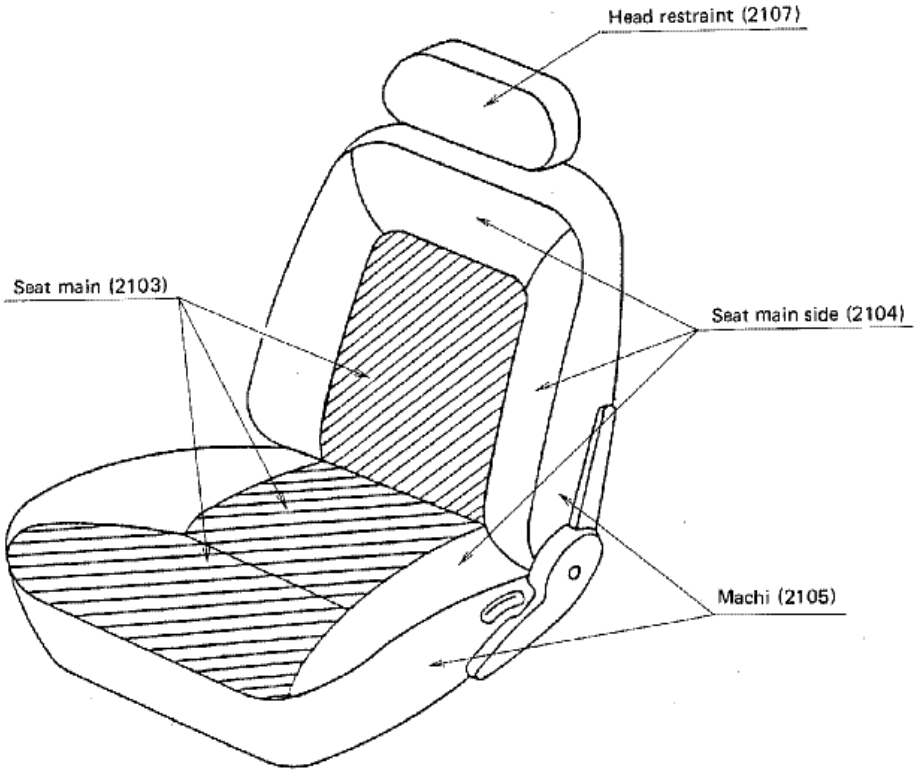
فضای اتومبیل و قطعات خودرو:

مرکز بهمن موتور، شرکت صنایع ریخته گری ایران ، شرکت شاسی ساز ایران ، مرکز بهمن دیزل ، شرکت مزدا یدک ، شرکت ایران دوچرخ ، شرکت عصر بهمن ، و شرکت بهمن لیزینگ در فضای خودرو و قطعات، محصولات و خدمات متنوع و در برخی موارد منحصر به فرد به صنعت کشور و جامعه ارائه می نمایند .مرکز بهمن موتور با تولید انواع وانت تک کابین و دوکابین مزدا ، آمبولانس مسقف ، سواری 323FL - GLX مزدا و پاجرو ، شرکت صنایع ریخته گری ایران با تولید انواع سیلندر ، سرسیلندر و قطعات متفرقه خودرو ، شرکت شاسی ساز ایران با تولید انواع شاسی خودروهای سنگین و سبک ، شرکت مزدا یدک با ارائه خدمات پس از فروش باتعداد ۱۰۶ نمایندگی در سراسر کشور (در حال حاضر) شرکت ایران دوچرخ با تولید انواع موتور سیکلت و دوچرخه به عنوان نماینده شرکت یاماها ژاپن در ایران و عصر بهمن با ارائه خدمات بازرگانی بین المللی خودرو به گروه و فضای خودرو، کوشش می دهند.

CHAPTER 1

INSPECTION STANDARD FOR SEAT

INSPECTION STANDARD FOR TRUCK SEAT



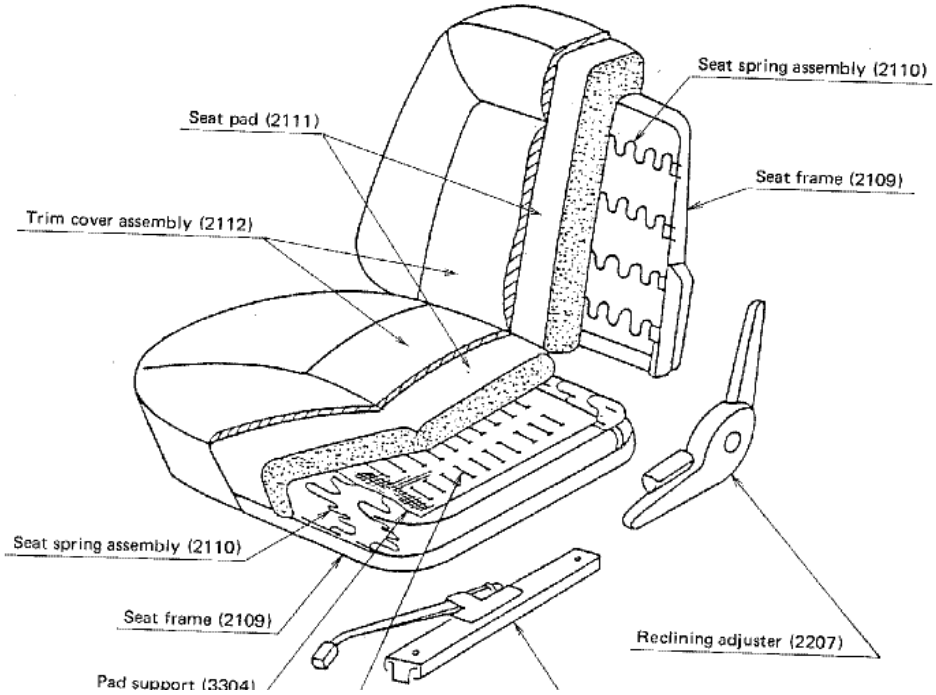


Fig. 15

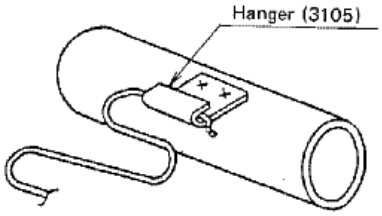


Fig. 16

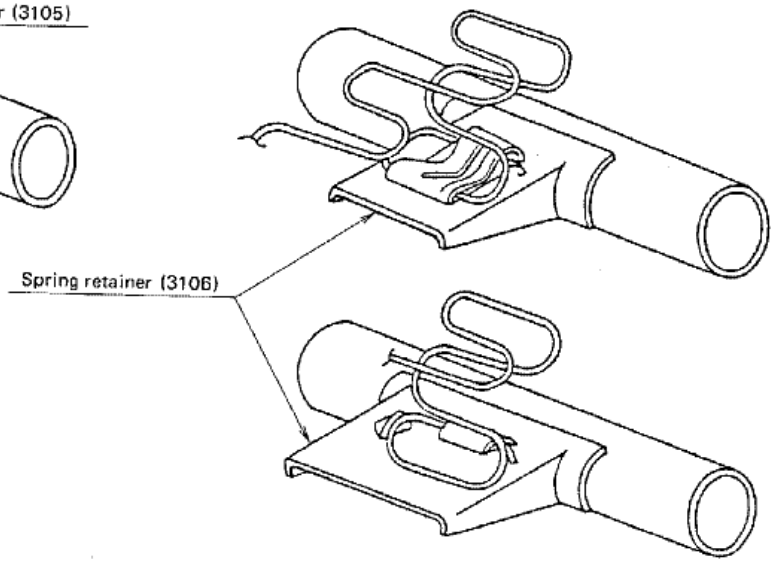


Fig. 17

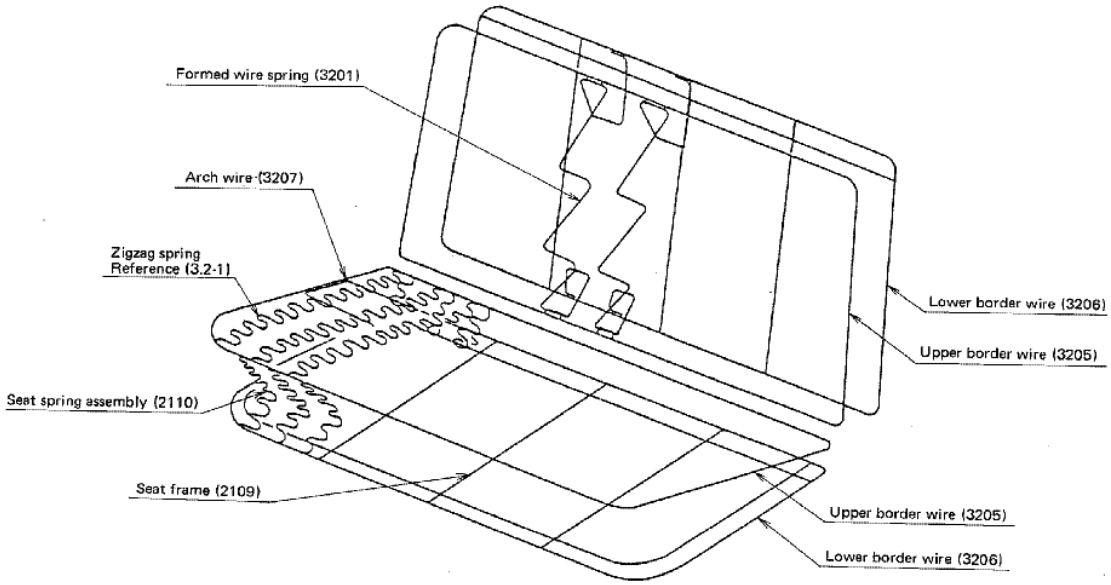


Fig. 18 Zigzag spring (Reference 3.2-1)

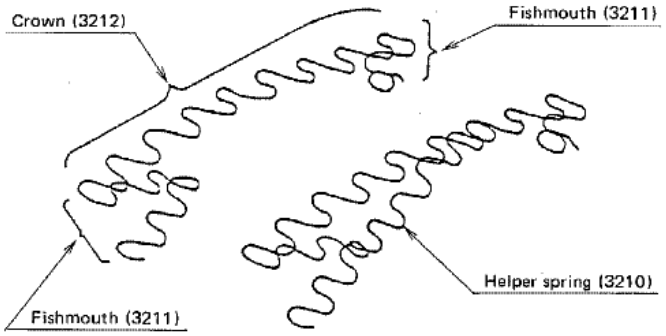


Fig. 19

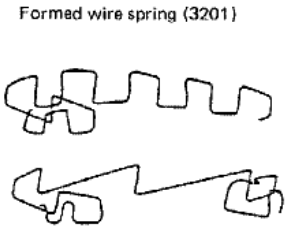


Fig. 20

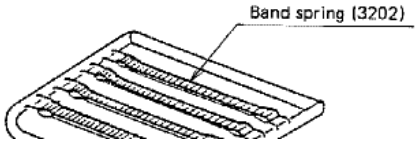
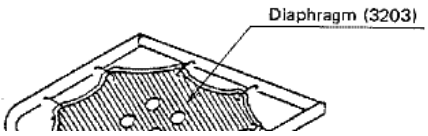


Fig. 21



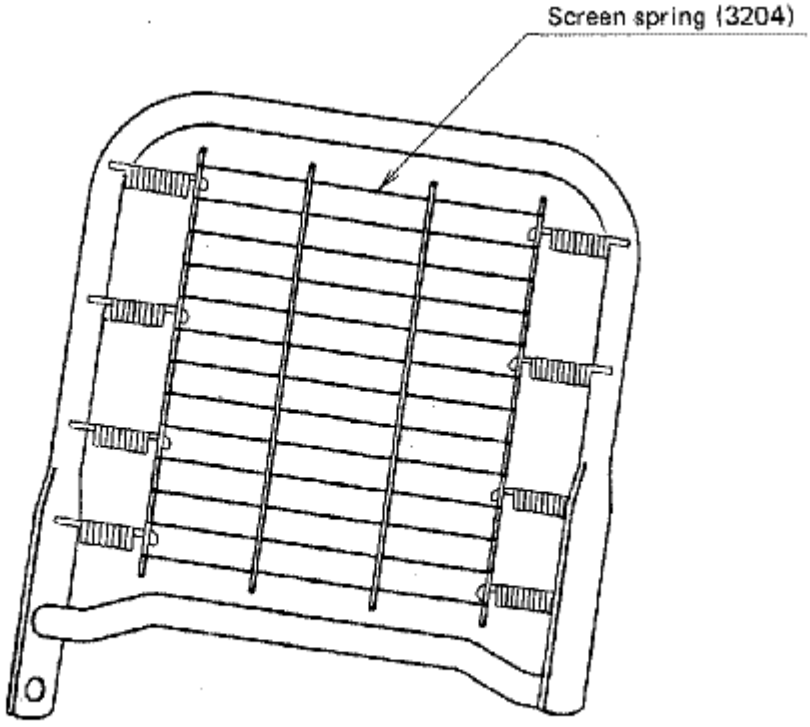


Fig. 23

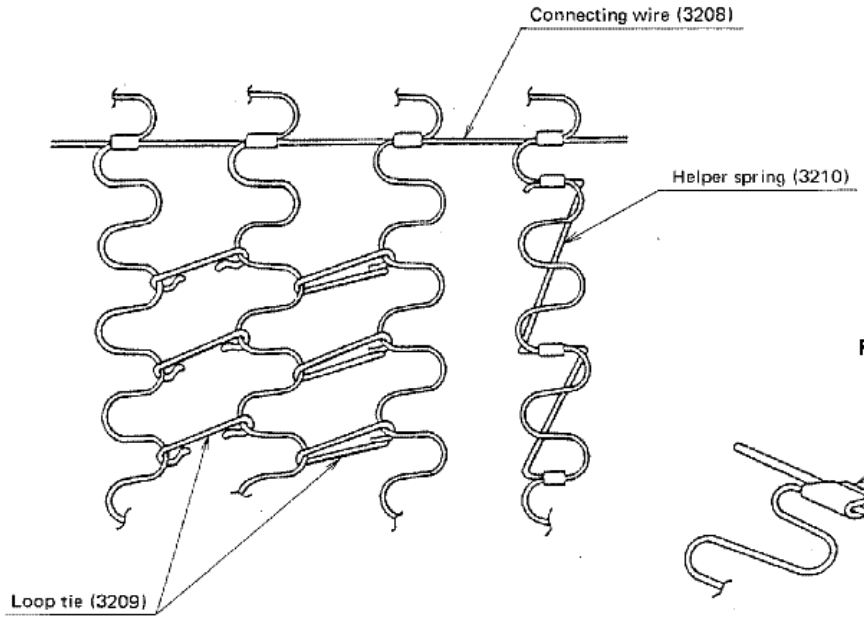


Fig. 25

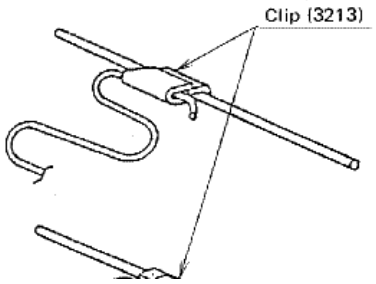


Fig. 24

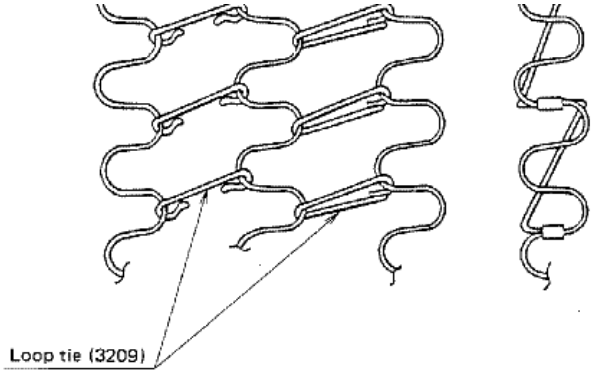


Fig. 25

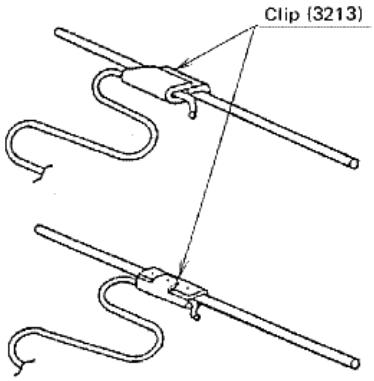


Fig. 24

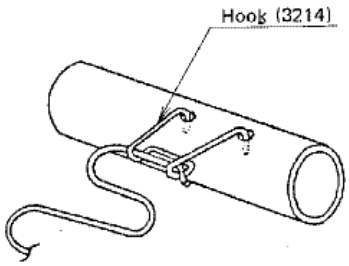


Fig. 26

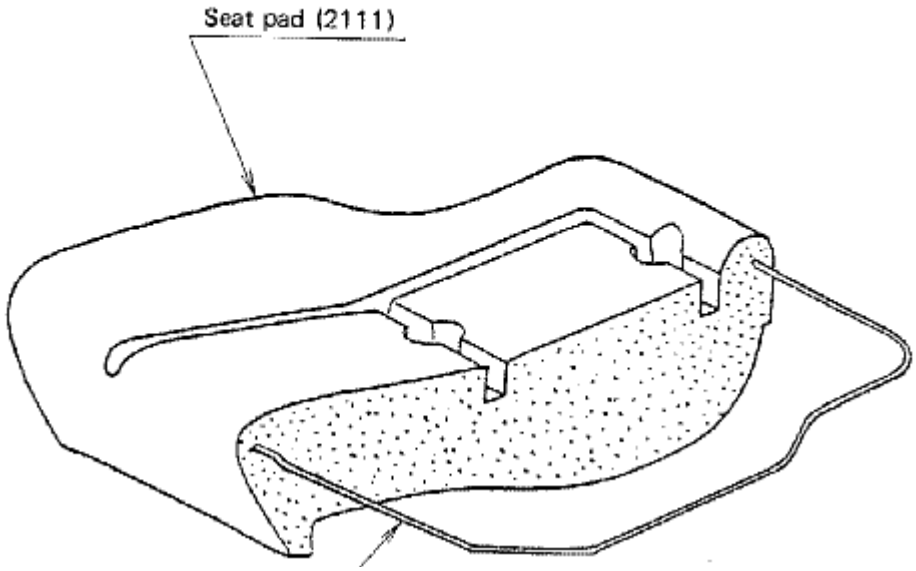


Fig. 27

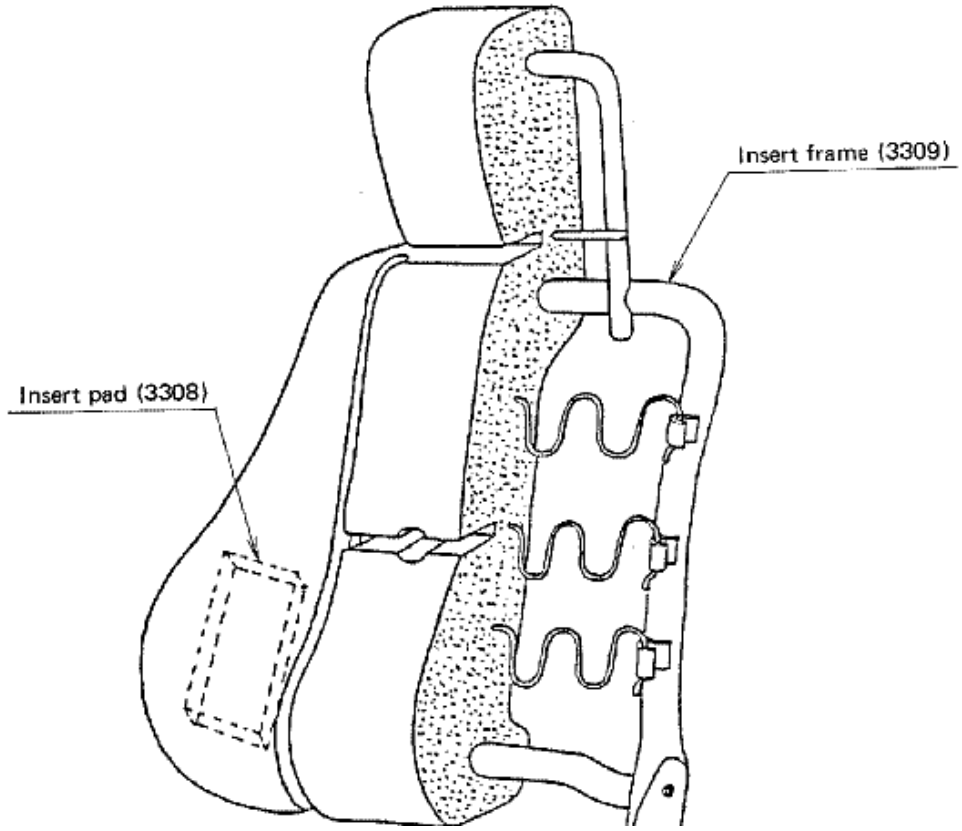


Fig. 28

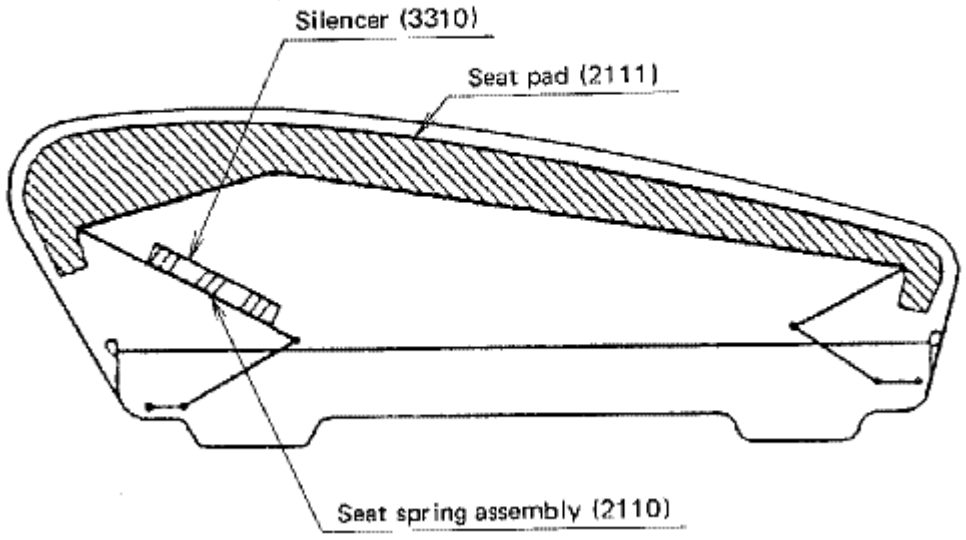


Fig. 29

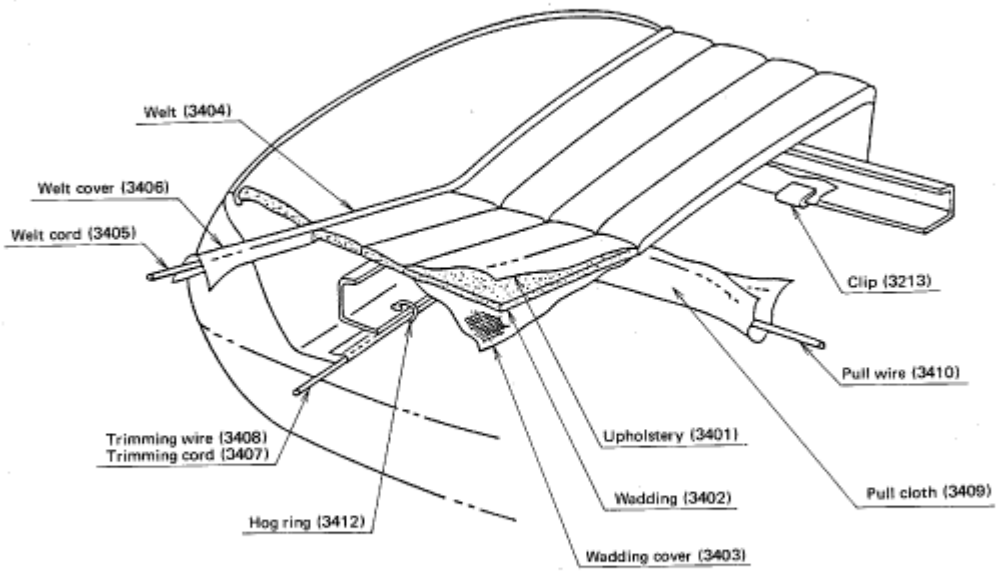


Fig. 30

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 performant	Damping waveform
		Logarithmic decrement

جدول شماره ۲ تست های کاربرد پذیری

Table 2 Test Applicability

Kind of test \ Kind of the test piece	Seat cushion	Seat back
Load Test	○	○
Hardness Distribution Test	○	○
Surface Hardness Test	○	○
Vibration Test	○	—
Damping Test	○	—

Remark: ○ Test applicable

جدول شماره ۳ کاربرد صفحه های فشرده

Table 3 Application of Pressing Plates

Kind of the test piece / Kind of seat	Seat cushion	Seat back
Load Test	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	—
Damping Test	JM-Type, AM-Type, "Tekken"-Type	—

5.2.2 Setting Directions of Pressing Plates

(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**

Table 3 Application of Pressing Plates

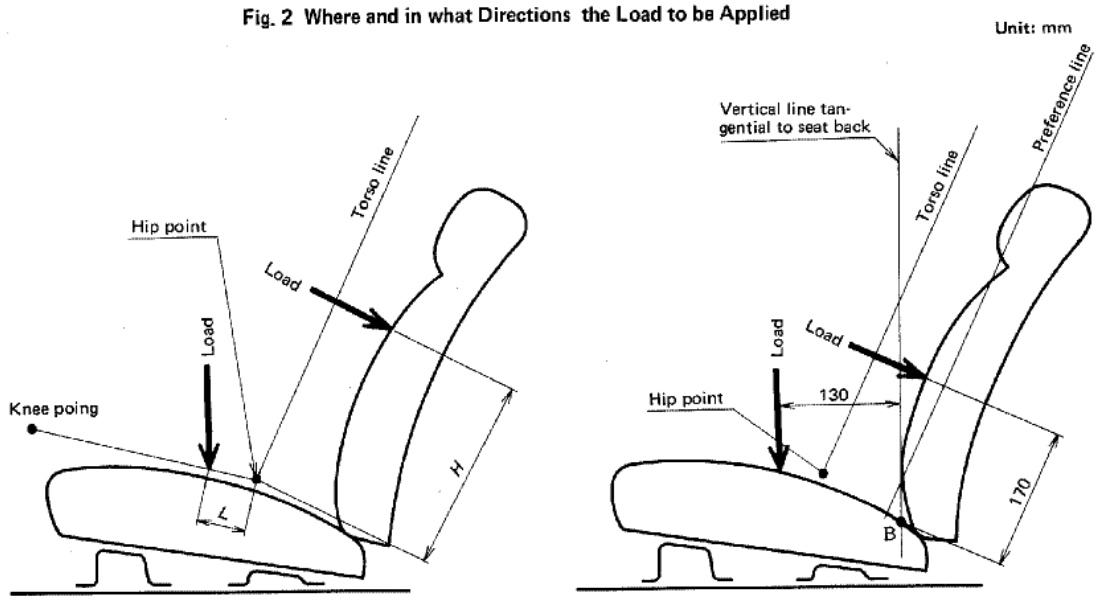
Kind of the test piece / Kind of seat	Seat cushion	Seat back
Load Test	JM-Type, AM-Type, "Tekken"-Type	JM-Type, AM-Type, "Tekken"-Type
Hardness Distribution Test	Column-Type	Column-Type
Surface Hardness Test	Column-Type	Column-Type
Vibration Test	JM-Type, AM-Type, "Tekken"-Type	—
Damping Test	JM-Type, AM-Type, "Tekken"-Type	—

5.2.2 Setting Directions of Pressing Plates

(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**

این شکل جهت نیروی وارد شده و همچنین چگونگی تعیین خط مرجع نقطه Bرا نشان می دهد .

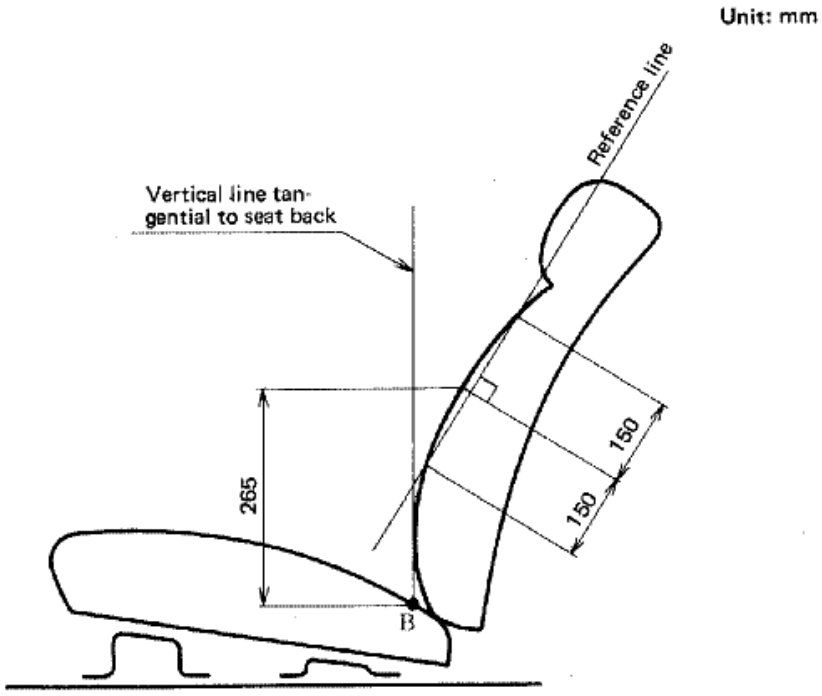
Fig. 2 Where and in what Directions the Load to be Applied



Unit: mm

Pressing plate	L	H
JM-Type	32	292
AM-Type	32	302

Fig. 3 How to Determine B Point and Reference Line



جدول ۴ بارها برای فشار اولیه

Table 4 Loads for Preliminary Pressing

Unit: kgf {N}

Kind of pressing plate \ Kind of the test piece	Seat cushion	Seat back
JM-Type	71 {700}	41 {400}
AM-Type	87 {850}	51 {500}
"Tekken"-Type	71 {700}	31 {300}

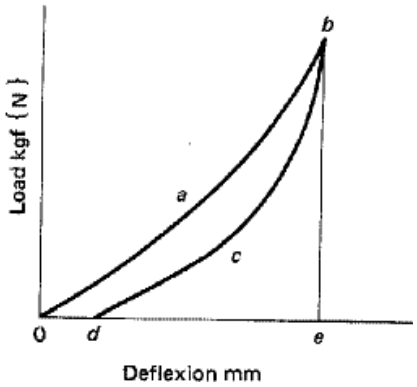
منحنی خیز بار

Table 4 Loads for Preliminary Pressing

Unit: kgf {N}

Kind of pressing plate \ Kind of the test piece	Seat cushion	Seat back
JM-Type	71 {700}	41 {400}
AM-Type	87 {850}	51 {500}
"Tekken"-Type	71 {700}	31 {300}

Fig. 4 Load-Deflection Curve



تعداد مقادیر عددی برای مقادیر مشخصه شاخص

Table 5 Number of Digits of Numerals 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).

جدول ۶ اندازه گیری خیز بارها

Table 6 Loads for Deflection Measurement

Unit: kgf {N}

Kind of pressing plate \ Kind of the test piece	Seat cushion	Seat back
JM-Type	51 {500}	26 {250}
AM-Type	61 {600}	31 {300}
"Tekken"-Type	46 {450}	15 {150}

(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.

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

where, α: Coefficient of Hysteresis Loss (%)

منحنی های سختی توضیح شده در شکل ۶ موقعیت نقاط بارگذاری

Fig. 5 Location of Loading Points

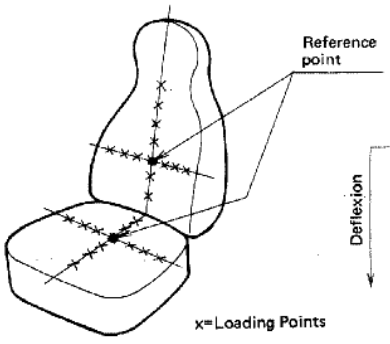
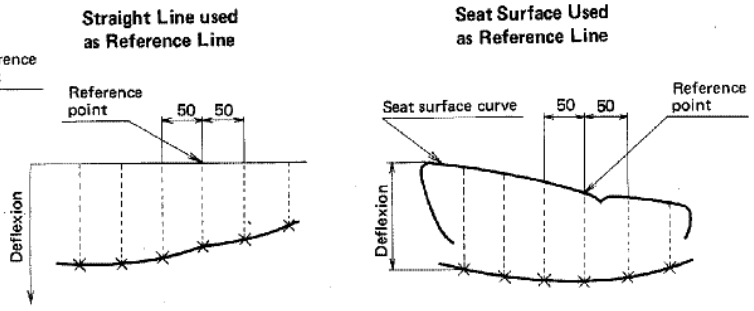


Fig. 6 Hardness Distribution Curves (Examples)

Unit: mm



Remark: The curves shown above denote the deflections of

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 **5.3.2** 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 **5.3.1.**

6.3.3 Initial Load and Loading Speed

Apply the initial load of 0.5 kgf {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 6 kgf {60N} at the loading speed of 150~300 mm/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 4 kgf {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 4 kgf {40N} is applied.

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 **5.3.2** become vertical.

6.4.2 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 **5.3.1.**

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 indicated in **Table 6.**

6.4.4 Total Amplitude and Frequency

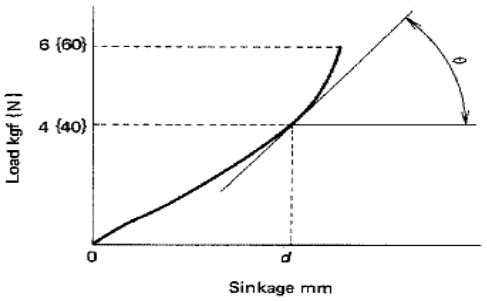
Total vertical amplitude of the shake table shall be selected from among 2, 5, 10, 15 and 20 mm. The exciting frequency shall be within the range from 1 Hz up to a frequency to exceed the resonance frequency by 2 Hz or more. The shaking wave shall be sine wave, as a rule.

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.

منحنی فرورفتگی بار در شکل ۷

Fig. 7 Load-Sinkage Curve



Amount of Sinkage = d (mm)

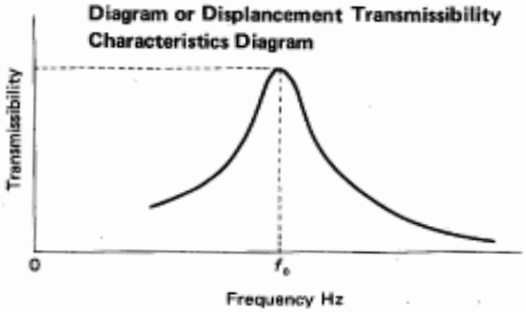
Static Spring Constant = tan θ (kgf/mm {N/mm})

تست دمپینگ (میرا شدن)

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 (9800 mm/s^2)

Note (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

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 **5.3.2** 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 **5.3.1**.

6.5.3 Mass of Pressing Plate

Mass of the pressing plate shall be equivalent to the load for the preliminary pressing indicated in **Table 4**.

6.5.4 Drop Height and Damping Wave Measuring Position

Raise the pressing plate to any point arbitrarily chosen within the distance up to 20 mm 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

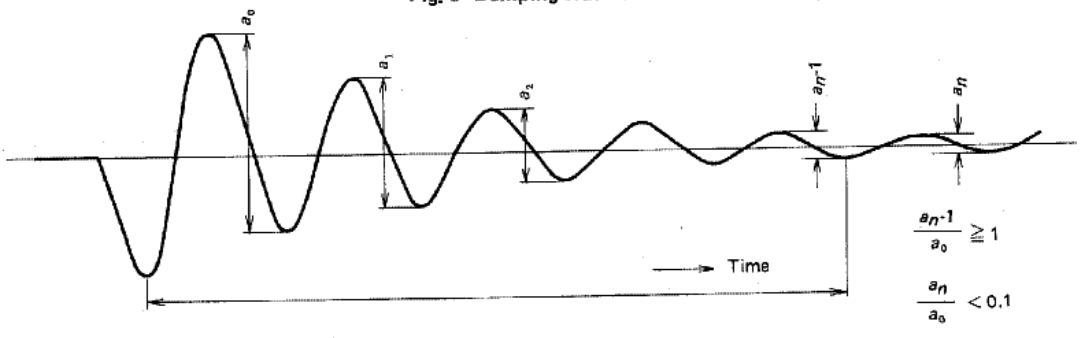
Using the damping waveform diagram as shown in **Fig. 9**, obtain the logarithmic decrement from the following formula for examining the damping performance.

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

where, λ: Logarithmic decrement
a: Amplitude
n: Number of waves which have been read. The waves shall be read until the ampli-

شکل امواج ناشی از دمپینگ(میرا شدن)

Fig. 9 Damping Waveform



Remark: The waveform shown above denotes the damping

CHAPTER 2

Leaf springs for automobiles

Leaf Springs for Automobiles

1. Scope

This Standard specifies normal leaf springs intended to be used for automobile body suspension (here in after called as springs), having the leaf width up to 100 mm.

Remark: Units and numerical values shown in { } are based on the System of International Units (SI), added as reference.

2. Purpose of Standardization

As opposed to general mechanical parts, springs are the structural components having another function of attaching wheel axles to the body than the inherent function as springs. Accordingly, simplification of kinds of springs shall be accompanied by that of body kinds. Because of such difficulty of prescribing kinds of springs, this standard aims to standardize materials and components of springs, the method of determing spring characteristics, shapes and dimensional standards relating to manufacturing process, etc. in order to rationalize the design, manufacture and inspection thereof.

Reference: In designing springs, detailed designs and specifications must be sufficiently discussed with the manufacturer prior to the final decision, after the main specifications for the spring characteristics and the spring attaching performance have been determined by the user. In this case, the agreement concerning the materials, dimensions and spring characteristics, etc. shall be limited to the extent required to maintain the performance of spring in consideration of manufacturing and inspectional conditions of the spring concerned.

3. Materials

3.1 Classes of Steels

The classes of steels for springs shall be SUP6, SUP9, SUP9A or SUP 11A specified in **JIS G 4801** (Spring Steels).

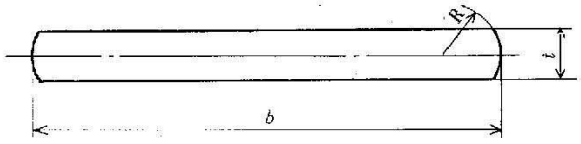
3.2 Dimensions of Flat Bars for Springs

Flat bars for springs shall be classified into 2 Types, B (Otsu-shu in Japanese) and C (Hei-shu in Japanese), and the dimensional tolerance shall be as follows.

(1) Cross Section of B Type (Otsu-shu in Japanese)

The shape of cross sectional shall be as shown in **Fig. 1**, and the dimensions and dimensional tolerances shall be as shown in **Table 1.**

Fig. 1



Applicable Standards: Refer to page 8.
Reference Standards : Refer to page 8.

Table 1

Unit : mm

Width		Thickness t														
		5	6	7	8	9	10	11	12	13	14	16	18	20	22	25
b	tol.	Tolerance on Thickness														
45	±0.50	±0.15	±0.15					±0.25								
50	±0.60	±0.15	±0.15	±0.18	±0.20	±0.20	±0.25	±0.25	±0.25	±0.30	±0.30					
60	±0.60	±0.15	±0.15	±0.18	±0.20	±0.20	±0.25	±0.25	±0.30	±0.30	±0.30	±0.35	±0.35			
70	±0.80		±0.18	±0.18	±0.20	±0.25	±0.25	±0.25	±0.30	±0.30	±0.30	±0.35	±0.35	±0.40	±0.45	±0.50
80	±0.80			±0.20	±0.20	±0.25	±0.25	±0.30	±0.30	±0.30	±0.30	±0.35	±0.35	±0.40		
90	±1.00					±0.25	±0.25	±0.30	±0.30	±0.30	±0.30	±0.35	±0.35	±0.40	±0.45	±0.50
100	±1.00							±0.30	±0.30	±0.30	±0.30	±0.35	±0.35	±0.40	±0.45	±0.50

Remarks: 1. The thickness shall be measured at the bothe edges, and the difference in thickness between the both edges shall be with in 25% of tolerance values on thickness prescribed in Table 1 (however, the minimum value shall be 0.1 mm).

2. The both surfaces shall be normally flat, and shall not be convex.

3. The values of the radius R on both ends are not specified.

(2) Cross Section of C Type (Hei-shu in Japanese)

The shape of cross section shall be as shown in **Fig. 2** and the dimensions and dimensional tolerances shall be as shown in **Table 2.**

Fig. 2

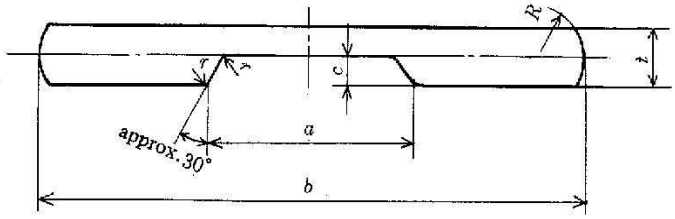


Table 2

Unit mm

Width		Thickness t				
		9	10	11	12	13
b	Tol.	Tolerance of Thickness				
70	±0.80	±0.25	±0.25	±0.25		
90	±1.00		±0.25	±0.30	±0.30	±0.30
100	±1.00				±0.30	±0.30

Remarks: 1. The thickness shall be measured at the both edges and the difference in thickness between the both edges shall be within 25 % of tolerance values of thickness prescribed in **Table 2.**

2. The dimensions of grooves shall be, as a rule, as follows;

The width a of the groove shall be 1/3 of the width b, and the depth c of the groove shall be generally 1/2 of the thickness t.

3. The values of the radius R on the both edges and the radius r on the corner of the groove are not specified.

4. The eccentricity of the center line of the groove, shall be, as a rule, 1/100 x b or less.

4. Main Characteristics of the Springs

4.1 Definitions

(1) **Camber** – The distance marked C in **Figs. 3,4 and 5.**

(2) **Height** – The distance marked H in **Figs. 3,4 and 5.**

(3) **Span** – The distance marked L in **Figs. 3,4 and 5.**

(4) **Span at Fixed End** – The distance marked L_1 in **Figs. 3 and 4.**

Fig. 3

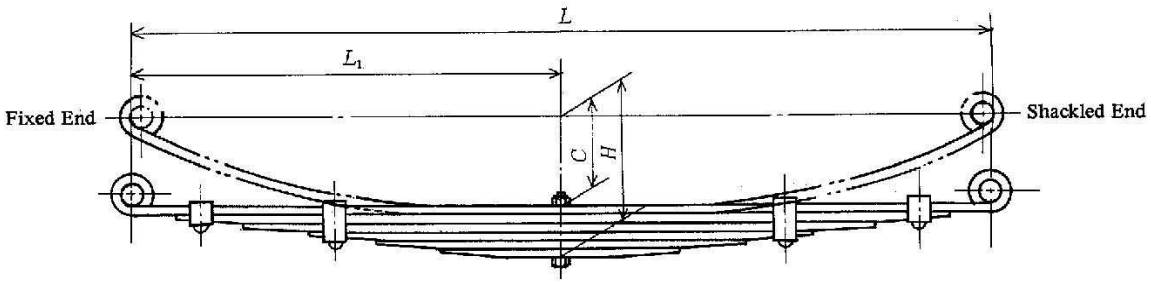
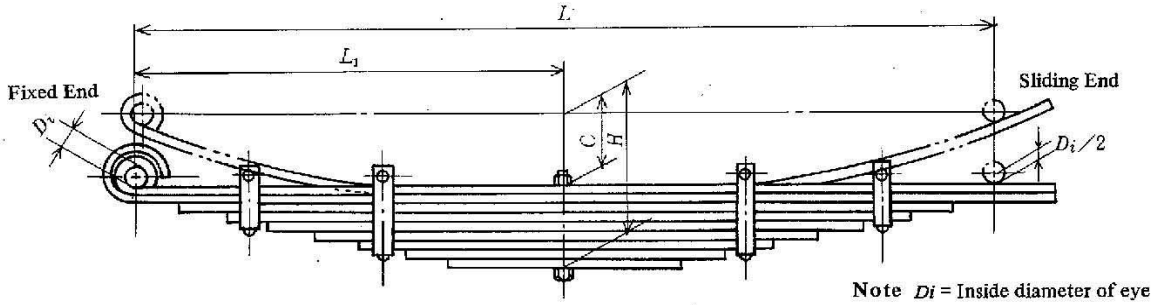
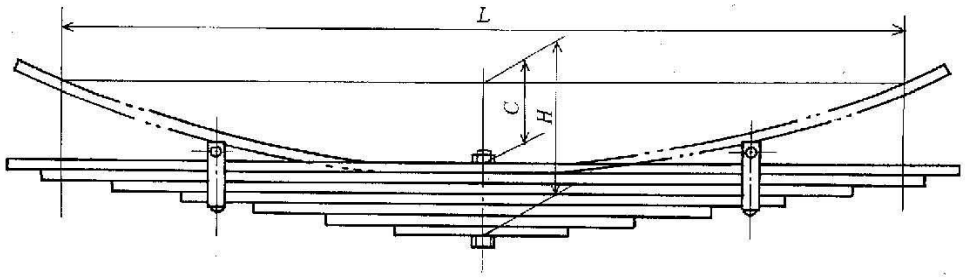


Fig. 4



Note Di = Inside diameter of eye

Fig. 5



4.2 Spring Characteristics

4.2.1 Designation of Spring Characteristics

As regards spring characteristics, the following (1) and (2) shall normally be specified. However, (3) may be specified in case it is specially required.

(1) The camber or height under designated load.

(2) The load under designated camber or height.

(3) The spring constant.

In case the spring constant is specified, the designation of the free camber or free height shall be given only to the approximate dimensions.

Reference: In case it is desired to specify strictly the spring characteristics for progressive springs, two points may be selected and designated. One of these points, however, shall be for reference only.

4.2.2 Measurement of Spring Characteristics

The measurement of spring characteristics shall be conducted according to the following (1) to (3).

(1) Upon application of load, the ends of the spring shall be supported with little friction.

(2) The loaded camber or height shall be measured under the load condition where load is gradually increased to the designated point.

(3) The spring constant shall be obtained from the designated point and another point determined by the agreement.

Reference: According to **JIS B 2701** (Leaf Springs), the measurement of spring constant is made at two loaded points besides the designated loaded point, therefore the measurement shall be made at three loaded points in total if the point is thus designated. However, in this standard, it is stipulated that it can be obtained from two points in order to improve the efficiency of test.

4.2.3 Tolerance on Spring Characteristics

Tolerance on spring characteristics shall be pursuant to the following **(1)** to **(5)**.

(1) Tolerance on Camber under Designated Load (mm)

It shall be ± [2.5mm + 2.5% of planned deflection (mm) under designated load]. Provided, however, that the minimum value of [2.5mm + 2.5% of planned deflection (mm) under designated load] shall be 4mm. The rounding-off method of numeric values shall be based on the unit of 0.5mm, in accordance with **JIS Z 8401** (Rules for Rounding-off of Numeric Values).

(2) Tolerance on Height under Designated Load (mm)

It shall be ± [4mm + 2.5% of planned deflection (mm) under designated load]. Provided, however, that the minimum value of [4mm + 2.5% of planned deflection (mm) under designated load] shall be 5.5mm. The rounding-off method of numeric values shall be based on the unit of 0.5mm, in accordance with **JIS Z 8401**.

(3) Tolerance on Load under Designated Camber (kgf)(N)

It shall be ± [2.5mm + 2.5% of planned deflection (mm) up to the designated camber] x planned spring constant. Provided, however, that the minimum value of [2.5mm + 2.5% of planned deflection up to the designated camber] x planned spring constant shall be [4mm] x planned spring constant.

(4) Tolerance on Load under Designated Height (kgf)(N)

It shall be ± [4mm + 2.5% of planned deflection (mm) up to the designated height] x planned spring constant. Provided, however, that the minimum value of [4mm + 2.5% of planned deflection (mm) up to the designated height] x planned spring constant shall be [5.5mm] x planned spring constant.

Remark: In case the tolerance value must be made smaller than the minimum values in **(1)** to **(4)** due to the regulation on the vehicle height or the difference in right and left of vehicle height, etc., it shall be pursuant to the agreement between the parties concerned.

(5) Tolerance on Spring Constant

It shall be ± 10% or ± 7%.

Reference: Although it is generally desirable not to designate the tolerance on spring constant, ± 10% tolerance must be allowed if possible, when its numerical designation is necessary. The reason is that if the tolerance on spring constant is specified to a smaller value, the selection of spring leaves will be required to assemble the spring, for the tolerance on spring constant is subject to the tolerance on thickness of flat bars to be used in the spring. In cases where the tolerance should be set smaller than ± 7%, such values shall be pursuant to the agreement between the parties concerned.

4.3 Span

Span shall be designated when the spring is set horizontally, and the tolerance shall be ± 0.3% (mm) of the span, provided that the minimum value shall be 3mm. In case of designating the span at the fixed end, the tolerance shall be ±0.3% (mm) of the span at the fixed end, provided that the minimum value shall be 2mm.

4.4 Hardness

The hardness of the leaf after tempering shall be H_B 388 to 461 (diameter of cavity 3.10 to 2.85mm). Where the hardness shall be measured at the compression side near the leaf center.

Remark: As a temporary step, the hardness of HB 363 to 444 (diameter of cavity 3.20 to 2.90mm) shall also be allowed, for the time being.

5. Requirements for Manufacturing Process and Dimensions

5.1 Dimensions and Tolerances of Leaves

The tolerances on the length of a leaf and on the distance between the center hole or the center protrusion and spring end shall be specified only when they are required, and the values shall be determined by mutual consent.

5.2 Dimensions and Tolerances of Center Holes of Leaves

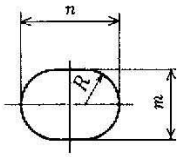
Dimensions and Tolerances of center holes of leaves shall be as listed in **Table 3** and **Fig. 6**

Table 3

Unit : mm

Dia. of Center Bolt		8	10	12	14	16
Dia. of Center Hole		$8.5^{+0.5}_{0}$	$10.5^{+0.5}_{0}$	$12.5^{+0.5}_{0}$	$14.5^{+0.8}_{0}$	$16.5^{+0.8}_{0}$
Dia. of Center Elliptic Hole of 2nd Leaf	Major Dia. *n*	$12^{+0.5}_{0}$	$14^{+0.5}_{0}$	$16^{+0.8}_{0}$	$18^{+0.8}_{0}$	$20^{+0.8}_{0}$
	Minor Dia. *m*	$8.5^{+0.5}_{0}$	$10.5^{+0.5}_{0}$	$12.5^{+0.5}_{0}$	$14.5^{+0.8}_{0}$	$16.5^{+0.8}_{0}$

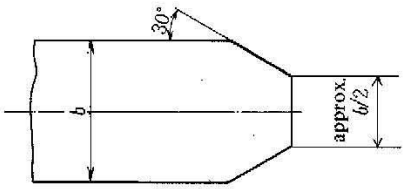
Fig. 6



5.3 Shapes of Leaf Ends

5.3.1 For timmed ends, the shapes shall be as shown in **Fig. 7.**

Fig. 7



Remark: For a leaf with a clip, square ends shall usually be used instead of trimmed ends.

5.3.2 For taper rolled ends, the plane figure of the leaf end shall not be specified.

5.4 Shapes of Eyes

5.4.1 Inside Diameter of Eye

The tolerance on inside diameters of eyes shall be as shown in **Table 4.**

Table 4

Unit : mm

Classification	Tolerance on Inside Diameter of Eye		
For those without bush or rubber bushes without external cover	Without Reaming	±0.50	
	With Reaming	A	±0.3
		B	±0.15
Metal bushes or rubber bushes with external cover	±0.15 or it shall be specified by the push-out force (the value of push-out force is subject to the agreement)		

Reference: In cases of those with reaming, the tolerances A and B on inside diameter of eye shall be selected in accordance with the required quality of the vehicle concerned.

5.4.2 Inside Diameter of Eye: For those without Bush or Rubber Bushes without External Cover

Inside diameters of eyes without bush or bushes without external cover shall be as shown in **Table 5.**

Table 5

Unit : mm

Inside Diameter of Eye										
23	25	28	30	33	35	38	40	43	45	50

5.4.3 Grinding of Eye Width

In case of designating the grinding of eye width, the specified size shall be that of less than 1 mm reduced from the leaf width, and the tolerance shall be $^{0}_{-0.5}$ mm.

5.5 Shape of Second Leaf

5.5.1 For a military wrapper, the main dimensions shall be subject to those shown in **Fig. 8** and **9** and **Table 6**. Other dimensions concerning the shape may be left to the manufacturer's option. In case of designating the tolerance specifically, it shall be limited only to the maximum dimensions, considering the space available.

Fig. 8

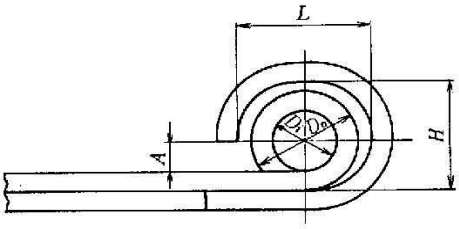
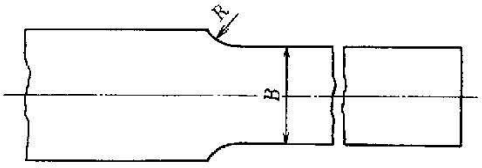


Fig. 9



R = approx. 10 mm

Table 6 Unit : mm

Leaf Width	45	50	60	70	80	90	100
B(approx)	35	40		60		75	
H(approx)	(D_0 + 3)						
L(approx)	(D_0 + 8)						
A(approx)	$Di/2$						

5.5.2 In case of winding it by 1/4 around the eye, it may be the cut-off shape as shown in **Fig. 9**, or trimmed end. The shapes and dimensions in such cases shall be determined by mutual consent.

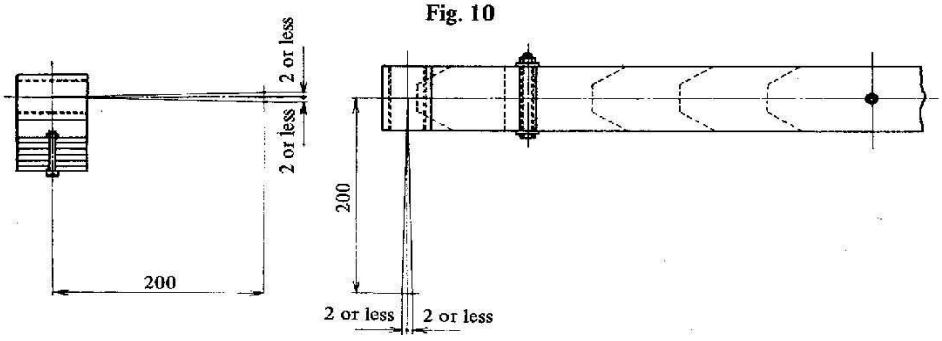
5.6 Others

Other dimensions shall be subject to designation and the tolerances shall be pursuant to **Table 7**.

Table 7

Item	Tolerance
Inclination of eye axis (For metal bush)	Pursuant to **Fig. 10**
Inclination of eye axis (For rubber bush)	According to agreement
Inside diameter of metal bush (When spring is completed)	H 10 specified in **JIS B 0401**
Assembled Spring Width	2.5% of leaf width between U bolts to attach springs. The width of springs with cup-center is subject to agreement

Fig. 10



6. Component Parts

6.1 Inside Diameter and Thicknesses of Metal Bushes

Inside diameters and thicknesses of metal bushes are as shown in **Table 8.**

Table 8 Unit : mm

Thickness \ I.D.	22	23	25	28	30	32	35	38
2.5	(27)	(28)	(30)					
3.0			(31)	(34)	(36)	(38)		
3.5				(35)	(37)	(39)	(42)	
4.0					(38)	(40)	(43)	(46)

Remarks: 1. The above shall be applied to standard-type metal bushes generally employed.

2. Dimensions shown in parentheses represent outside diameters of bushes.

Reference: Inside Diameters and Classes of Motor Vehicles to be Applied.

Unit : mm

Classes of Motor Vehicles	Inside Diameter of Bush
Small-sized Trucks and Buses	$\phi 22 \sim \phi 25$
Medium-sized Trucks and Buses	$\phi 25 \sim \phi 32$
Large-sized Trucks and Buses	$\phi 28 \sim \phi 38$

6.2 Materials, Shapes and Dimensions of Center Bolts

The grade of mechanical properties of center bolts shall be one of 6T, 7T, 8.8 or 10.9 specified in **JIS B 1180** (Hexagon Head Bolts) and surface treatment shall not be applied. Shapes and dimensions shall be as shown in **Fig. 11** and **Table 9.** As regards nuts to be employed in center bolts, small sized hexagon nuts specified in **JIS B 1181** (Hexagon Nuts) shall be used.

Fig. 11

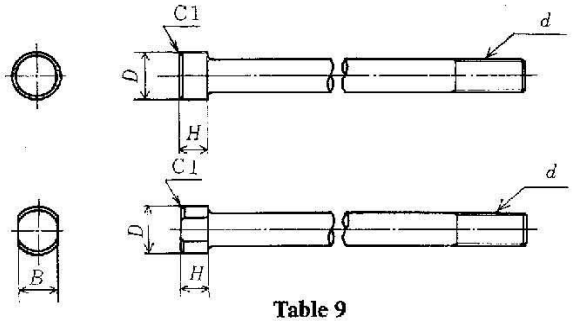


Table 9 Unit : mm

d	M 8		M 10			M 12		M 14		M 16	
D	14	(15)	14		16	17	20	20	22	24	30
B	—	—	—	12	14	14	17	17	17	19	27
H	(4)										
	6	(6)	8	8	8	(8)					
	8		10			10	10	10	10	10	
	10		12			12	12	12	12	12	12
	14		14			15	15	15	15	15	
	16	(18)				(20)		(20)			

Remark: The use of dimensions enclosed in parentheses shall be avoided to the utmost.

6.3 Materials and Dimensions for Clips

Materials for clips shall be in general pursuant to SS34 and SS41 as specified in **JIS G 3101** (Rolled Steel for General Structure), and the dimensions shall be following 5 classes;

$3^t \times 20^b$mm,$5^t \times 20^b$mm,$6^t \times 25^b$mm and $6^t \times 30^b$mm and $8^t \times 30^b$mm.

6.4 Materials and Diameters of Clip Bolts

The grade of mechanical properties of clip bolts shall be, in general, 4T as specified in **JIS B 1180** (Hexagon Head Bolts), and the diameters shall be 2 classes of 8mm and 10mm.

6.5 Materials and Diameters of Rivets

Materials for rivets shall be in general SWRM10 and SWRM12 specified in **JIS G 3505** (Low Carbon Steel Wire Rods), and the diameters shall be as shown in **Table 10.**

Table 10

Unit : mm

Diameter of Rivet	6	8	10	13	16
Reference Leaf Thickness	—	up to 7	up to 9	up to 11	up to 16

6.6 Dimensions of Distance Piece

Dimensions of distance pieces to be used at the center bolt units of isoclamp-type of springs shall be as shown in **Table 11.**

Table 11

Unit mm

Nominal Diameter of Bolts	8			10
Inside D.	8.5			10.5
Outside D.	14	15	22	16

7. Coating for springs

The coating for springs shall be in general pursuant to **JIS C 0202** (General Rules of Coating Films for Automobile Parts), and details of the specifications shall be determined by agreement between the parties concerned.

Applicable Standards

JIS B 0401	Limits and Fits for Engineering
JIS B 1180	Hexagon Head Bolts
JIS B 1181	Hexagon Nuts
JIS B 2701	Leaf Springs
JIS B 2710	Design Standard of Leaf Springs
JIS D 0202	General Rules of Coating Films for Automobile Parts
JIS G 3101	Rolled Steel for General Structure
JIS G 3505	Low Carbon Steel Wire Rods
JIS G 4801	Spring Steel
JIS Z 8401	Rules for Rounding off of Numerical Values

Reference Standard

JASO C 604-70 (7017)	Strength Test Method for Motor Vehicles Suspension Springs

JASO C 601-79 Leaf Springs for Automobiles; Explanatory Notes

As regards the items deemed particularly important, necessary descriptions were given as references in the **Text.** Therefore, the items which could not be mentioned in the text are described in the followings.

3. Materials

3.1 Classes of Steels

At present, SUP6, SUP9, SUP9A and SUP11A are mainly used. Concerning the performance of these steels, it is desirable that each motor vehicle manufacturer selects the class of steel recommended by the respective spring manufacturer since the ways of recommendations are different according to the experience of spring manufacturers, especially by the respective spring steel manufacturer related to each spring manufacturer. Upon present deliberation, additions and amendments to the Text concerning classes of steels were made in accordance with the amendments to **JIS G 4801** Spring Steel Material Standard.

3.2 Dimensions of Flat Bar

(1) As regards the classes of dimensions listed in **Table 1** and **Table 2**, the most heated debate had arisen from the very beginning of the establishment of this standard. Therefore, the participation of spring steel manufacturers was requested as usual by the sub-committee upon previous deliberation.

(2) In regards to the classes of dimensions of the cross section of type B (Otsu-shu in Japanese) listed in **Table 1**, the results of surveys on the recent status of use were also reflected into the study conducted this time, and following amendments were made accordingly.

(a) Although it had been decided by the past deliberations, that those having the thickness up to 18mm be listed in **Table 1**, of the **Text**, and those having the thickness of 20mm and over be mentioned in the **Explanatory Notes**, it was decided upon previous deliberation that those having the thickness of 20mm and over be also indicated in the **Text** as included in **Table 1**, for a considerable amount of usage was actually observed this time, and demands for them were anticipated in future in relation to the design. As for those having the thickness of 18mm and over, however, it must be considered that the material cutting and manufacturing processes such as the eye winding of main leaf, etc. are difficult. Those having the thickness of 15mm and 23mm had been eliminated, for the actual amount of use was negligible, while those having the thickness of 22mm had been added upon previous amendment. Thus the number of kinds listed in **Table 1** was increased from 61 to 67, with a significant increase in those having larger thickness. Upon the recent deliberation, those having the size of 50 x 14mm, 60 x 14mm and 60 x 18mm were newly added and specified in the **Text** after reconsideration to meet the demand which resulted from the recent tendency to reduce weight of large size springs.

(b) As regards those having the thickness of 4mm, it was decided, as usual, not to specify them in **Table 1** since they are not suitable for ordinary use because of rolling problems, although they are still being used at present. However, the followings are recommended in cases where the use of those with 4mm thickness is inevitable.

$45^{b} \times 4^{t} \pm 0.15$mm $\quad 50^{b} \times 4^{t} \pm 0.15$mm $\quad 60^{b} \times 4^{t} \pm 0.18$mm

(c) Although the tolerance for those having 60mm width and 5mm thickness had been specified as ± 0.18mm by the past deliberations, it was changed to ± 0.15mm by the previous deliberation.

(d) The kinds number of material dimensions showed some tendency of increase from the deliberation preceding the previous one, contrary to the intension of simplification. Some opinion was presented indicating that it would be necessary to study the possibility of reducing the number of leaf widths to promote the simplification in future, for it was difficult to reduce the number of the thicknesses in terms of design, and the width of 45mm was mentioned as the possible object of the elimination.

(e) Although the leaf width is specified to be less than 100mm in the **Text**, there are recent cases where leaf widths exceeding 100mm are employed in special purpose vehicles. Concerning the width exceeding 100mm, the widths of 115mm, 125mm, 150mm and 180mm have been specified by **JIS G 4801** (Spring Steels). Nevertheless, at the previous deliberation, all widths other than 150mm had been eliminated on the basis of the actual status of the usage. Therefore, it is desirable to carry out sufficient deliberations in those cases where width exceeding 100mm should be used.

(3) **Table 2** in Cross Section of C Type (Hei-shu) eliminated width of 80mm as well as 70 x 8mm and 100 x 11mm, on the basis of the survey results regarding the actual usage status at the previous deliberation.

Although the cross section was established to reduce weight, it may be necessary in the future to re-examine it according to the conclusions that may be drawn by the Spring Technology Research Committee which has commenced a study on cross sections including this one, aimed at weight reduction.

4. Main Characteristics of Springs

4.2 Spring Characteristics

4.2.1 Designation of Spring Characteristics

It had formerly been decided to specify the camber or height under designated load, but it was decided at the deliberation preceding the previous one, that the load under the designated camber or height may also be specified. This provision was added at the previous deliberation as it is desirable to make a clear indication in terms of standards because the method to measure the load on the basis of height is more effective and popular in spring tests although both methods mentioned above have the same characteristics for springs.

4.2.3 Tolerance on Spring Characteristics

The minimum values have been specified respectively for the tolerance on the camber under the designated load, the height under the designated load, the load under the designated camber and the load under the designated height. Recently, the designated point tends to be that under the unloaded state rather than that under the normal loaded state. This results in the smaller planned deflection under designated load that, in turn, makes it difficult to satisfy the tolerance. Therefore, spring manufacturers had made research survey regarding camber upon preceding deliberation, and it was found that the insufficiency account for more than 10% of the total in case the tolerance was ± 3mm ~ ± 3.5mm, 6 ~ 8% in case of the tolerance of ± 4mm, and 1 ~ 3% in case of the tolerance of ± 5mm. This inevitably resulted in the increase in the re-adjustment process and the total number of manufacturing processes which, in turn, had significant effect on the cost. Thus the minimum values for the tolerances were established to relieve the difficulties in the manufacturing process. At the present deliberation, automobile manufacturers requested as they had done at the previous deliberation, that the tolerance should be further reduced because it might be necessary because of the regulation of vehicle height. However, after discussions it was left to the future deliberation, since difficulties might lie among spring manufacturers to cope with such amendment at present stage.

4.3 Span

It has been specified in the **Text** that "span shall be designated when the spring is set horizontally, and the tolerance shall be ± 0.3% (mm) of the span". Spring manufacturers, nevertheless, can adjust the span only during the eye winding process. It has been questioned in the deliberation preceding the previous one, that the span under the horizontal spring condition had not necessarily satisfied the tolerance. According to the survey made on the actual conditions of spring manufacturers, it was found that the range of fluctuations is apt to increase for horizontal spans of springs during eye winding process even if the tolerance can be fully satisfied due to the difference in the slight waving phenomenon that occurs in the main leaf while the spring is set horizontally. Because of the fluctuation as mentioned above and the deviation between the center value and the mean value, it was found as inevitable to have several percent of the lods insufficiency. Nevertheless, it was decided to leave the provision as stated in the **Text**, for it was not desirable to enlarge the range of tolerances in relation to comparable standards in U.S.A. and Europe. It is thus recommended that the agreement be made among parties concerned in terms of quality control, for the condition under which the eye of main leaf is being wound.

4.4 Hardness

At the current deliberation, spring manufacturers proposed the amendment of hardness provision of springs (from HB 363 – 444 to HB 388 – 461) in regard to the reduction of the weight of springs and the achieved improvement not only of quality of spring material but also of techniques of the heat treatment in manufacturing process. Although automobile manufacturers agreed to the proposal in principle, it was also anticipated that the immediate change of provisions concerning weight and hardness might bring out debates. Therefore, it was stipulated that, for the certain period of time, former hardness standard be also applicable. Thus the amendment had been made and specified in the **Text**.

5. Requirements for Manufacturing Process and Dimensions

(1) Dimensions of Leaves

It was decided on the deliberation preceding the previous one, that the tolerance on the length of a leaf should not be specified as long as no trouble occurs in attaching springs. This is based on the concept that tolerances be specified only for required characteristic values since severe provisions on the length of leaves — that of tapered leaf end in particular — may bring about some difficulties in the manufacturing process, for the spring characteristics had been already specified.

(2) Shapes of Eyes

Items related with the shape of eye for the amendament that was made by the preceding deliberation are summarized in **5.4** of the **Text.**

(a) According to the survey made on the current status of the inside diameter of the eye, it has been found that a number of various dimensions are being employed at the moment. It is, however, desirable to make standardization in terms of rationalization of the manufacturing process, and the study has been made accordingly to establish the standard dimensions. Nevertheless, it is too early to include the unified proposal in the **Text** due to the insufficient data to support the proposal. Thus it has been decided to mention the results of the deliberation in the **Explanatory notes.** The standard inside diameters were established as follows as guidelines for future designs only for springs that employ rubber bushes taking into the consideration that it is allowable to establish separate dimensions respectively for springs with metal bushes and those with rubber bushes, since the leaf thickness is different for each of them, and the inside diameters of eyes of springs with metal bushes are automatically established, for thickness of the bush inside diameters of springs with metal bushes have been specified in **6.1** of the **Text.**

25, 30, 35, 40, 45, 50mm

The survey made on the current status, however, has revealed that the use of those with intermediate diameter among established guidelines has been increased. Thus, to the **Text** added are those of intermediate diameter.

(b) Tolerances on inside diameters of eye for those without bush and those with rubber bush and non-covered tube are classified into those that require reaming and those which do not require reaming. The reaming for the eye inside diameters is different from other manufacturing processes for ordinary mechanical parts; the cutting is more difficult due to the facts that the hardness is higher and the possible deformation of eyes that may occur upon the insertion of reamers because the eye winding end is open. It is thus recommended to designate the tolerance of ± 0.5mm without reaming as long as there is no problem in the performance of springs, but A and B are separately established for those which require higher accuracy. It is, nevertheless, desirable to designate A (± 0.3mm) in terms of manufacturing process.

(c) As for inside diameters of the eye for metal bush or rubber bush with external cover, it was decided by the previous amendment that the former, which had not been specified in the previous standards, be handled by the same manner with the latter. Although the push-out force is more important than the tolerance in the actual use of these eyes, it has been decided that the values of the push-out force be determined according to each case, for it is difficult to specify uniform values in relation to the dimensions of leaves and bushes, and it is too early to make definite standards. As regards eyes with rubber bush covered by tube, examples were indicated during the deliberation preceding the previous one, that the provisions were applicable to passenger cars exceeding 700 kgf {6.9KN} in weight, small sized trucks with the weight 750 kgf {7.4KN}, and medium sized trucks with the weight exceeding 1,000 kgf {9.8KN}.

(d) In order to reduce the grinding time as much as possible, it has been decided that the specified size be less than 1 mm regardless of the leaf width, in case of designating the grinding of eye width.

(3) Shape of Second Leaf

The dimensions of a military wrapper with the both ends being cut-off had usually been specified by the width to be cut off from the both ends. However, it was amended by the deliberation preceding the previous one so that the dimensions be specified by the original width of the military wrapper to unify the cutting tools, as shown in **Fig. 9** of the **Text.**

(4) Assembled Spring Width

The tolerance on the assembled spring width had been specified as 2.5% of the leaf width between U bolts to

attach the springs. Nevertheless, it must be noted that there are cases where a cup center is attached to the center hole of the leaf, which often results in the expansion of the leaf width near the cup center. Since the provisions in the **Text** cannot be satisfied in such cases, it was decided by the preceding deliberation that the tolerance values for those with the cup center be determined by the agreement. The recommended value for the above is 5% of the leaf width.

6. Component Parts

(1) Inside Diameter and Thickness of Metal Bushes

As regards the inside diameter and thickness of metal bushes, the dimensions had been specified respectively. It was found by the preceding deliberation that the standard dimensions were being employed in most of the cases, but the thickness were not necessarily standardized. It is, nevertheless, still desirable to specify the standard dimensions in light of the unification of eye winding tools and the procedures of eye winding operations. Therefore, the standard dimensions were specified through the previous deliberation as listed in **Table 8**, taking into consideration of the combinations of the inside diameter and the thickness of the bushes. The relation between the inside diameter of the bushes and applicable vehicle types has also been added for reference. Concerning bush diameters, 16 mm, 18 mm, 20 mm and 40 mm have been eliminated. As regards bush thicknesses, 2.5 mm, 3.5 mm and 4 mm have been added to usual standard thickness of 3 mm in consideration to the relationship with the applicable vehicle types. An opinion has been expressed, nevertheless, that one of 3.5 mm and 4 mm may be selected and the other be eliminated in terms of the standardization. It is desired that this question be studied sufficiently in the future.

(2) Center Bolts

9T was added to the grades of mechanical properties of center bolts to make four different kinds by the previous deliberation. However, according to the amendment of **JIS B 1180–1974** (Hexagon Head Bolts), 8T and 9T was changed to 8.8 and 10.9 respectively. The number of grades is four as before. At the current deliberation many members expressed the opinion that the currently provided standard dimensions concerning center bolts might not be fitted to the actual conditions of usage. After a certain study, it was supported by majority, namely about seventy per cent of the members that only 27 kinds out of approximately 70 kinds which have been applied should be prescribed except those figures enclosed in parentheses in the **Text**. It was decided that considerations should be continued referring to the above mentioned suggestion as an index for the future amendment, and that most of the dimensions other than those should be added with parentheses. Center bolts with slitted head had been eliminated by the previous amendment according to the actual usage condition.

(3) Materials for Clips

In light of the fact that the materials for clips were usually selected from general low carbon steel, it was specified that SS34 and SS41 be used in general. However, it has been found by the recent survey that SWRM 8 or SWRM 10 rolled into flat plates are being used frequently, and some opinion has been thus expressed that these should be added accordingly. But the standardization was postponed due to the short period of the use at the previous deliberation.

(4) Clip Bolts

As for clip bolts, only the kinds of materials were specified and SS34 and SS41 has been employed as a rule. However, it was decided that the materials should be 4T bolts specified in **JIS B 1180**, at the preceding deliberation.

(5) Materials and Dimensions of Distance Pieces

Distance pieces are used as the spacers for the center bolts of isoclamp-type springs which are mainly employed for small-sized vehicles. At the previous deliberation, their standardization was postponed, but after the recent deliberation it was decided to standardize the dimensions, and thus, they are specified in **6.6** of the **Text**. Those concerning the height, however, which were regarded to have no merit of standardization were excluded.

7. Coating for Springs

The coating for springs covers shot-peened surface (tensile side), heat-treated surface (compressed side and glued surface) and the side surface where the inter-leaf can be seen. This presents many difficult problems different from

other automobile parts. Furthermore, there is the problem of the difference in the quality requirements resulted from the recent fluctuations in the painting conditions and the difference in the kinds of vehicles, which makes it difficult to specify the contents of specifications.

At the previous deliberation, it was thus mentioned particularly in the **Text** that concrete agreements should be made among parties concerned in such manner that the performance of springs should be not hindered, taking the workability and the economical efficiency into consideration.

Concerning the application method for the springs specified in **JIS D 0202** (General Rules of Coating Films for Automobile Parts), the following agreements were mentioned in the former **Explanatory Notes.** Namely, of the test items specified in **JIS D 0202** (General Rules of Coating Films for Automobile Parts), the scratch hardness test, the film thickness test and the adhesion test were to be conducted, and the implementation procedures were specified as follows;

(1) The salt water spray test shall be made by means of samples in the selection of coating.

(2) The scratch hardness test and the adhesion test shall be conducted by means of samples or products on the basis of agreement made among the parties concerned.

(3) The measurement of film thickness shall be made on products.

Although it had been agreed at the previous deliberation that further studies should be made concerning the above and discussions were made accordingly upon current deliberation, it was decided that the determination of specific provisions should be postponed to the next deliberation since every manufacturer was still under research stage.

Others

(1) Test Items

At the preceding deliberation, concerning the test items for springs, agreements were made respectively for each type of spring between the manufacturers and users. However, a request was made to rationalize the tests by unifying the contents to the necessary limits, on the basis of the purpose of the provisions made by the preceding deliberation, and a survey was conducted accordingly. It was found by the survey that it would be questionable to unify the contents, for there are significant differences in the details of each item. Thus, it has been decided not to unify the test items and enumerate them in the **Text**, but to mention them in the **Explanatory Notes** as the draft proposal, after making appropriate selection. It is desired that the test items are limited as much as possible, and rationalized in future according to the following table.

Classification	Items	Remarks
Characteristics	The camber or height under designated load. (The load under designated camber or height.) Spring constant The span under the horizontal condition. The fixed side span under the horizontal condition. Hardness Shot peening (Stress Peening)	———
Dimensions	Eye width The inclination of eye axis The inside diameter of metal bushes. The push-out force of bushes. The inside diameter of eye for bushes. Assembled spring width The diameter and height of center bolt head.	As grinded Metallic bush or rubber bush When the spring is completed. Metal bushes of rubber bushes with external cover Rubber only
Others	Coating Indication External appearance	———

(2) Long Taper Springs

There were many participants from chassis manufacturers, who requested at the deliberation preceding the previous one, the review of the springs with leaves which taper throughout the whole length. Since such springs are one of the new designs of leaf springs, the standards thereof, if adopted, will be those to specify the shapes and dimensions, for this particular standard does not deal with the design. It has been judged that it will be too early to restrict specifically the shapes and dimensions. The proposal, therefore, was deferred again by the current deliberation.

(3) Stress Peening Springs

It is the recent tendency to have stress peening rather than shot peening in order to improve the effectiveness of springs. Through the current deliberation it was suggested to provide the quality of stress peening springs and to have deliberation on determining substitutional characteristics. In general, the provisions of processing conditions such as the amount of arc height, coverage, initial stress, etc. are practiced. Nevertheless, there are still more problems such as wears of the spring surfaces and the influence of fretting corrosions around the bolted area on actual vehicles. The Spring Technology Research Committee is also carrying out various studies on these problems. In this respect, it was decided that these problems should be left to the future discussions and that concrete agreement should be made between orderers and manufacturers of springs.

Postscript

At the current deliberation the minimum amendments were made based on limited points proposed by each manufacturer. It is desired, however, that more comprehensive deliberations are made at the next amendment, including pending matters from the previous amendment.

Reference Standards:

SAE J 510 C Leaf Springs for Motor Vehicle Suspension

SAE J 1123a Leaf Springs for Motor Vehicle Suspension—Metric Bar Sizes

ASTM A 147. Standard Specification for Heat-Treated Steel Leaf Spring

Translation without guarantee.
In the event of any doubt arising, the original standards in Japanese are to be evidence.

C601^{-79}

Japanese Text

Established by the Standard Council of JSAE
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فصل ۳
استاندارد اتومبیل ژاپنی

فنر های تخت برای اتومبیل ها

مواد ها

کلاس فولاد

یک نوع کلاس فولاد بایدمطابق با استاندارد **JIS G 4801** از نوع فولاد های فنری **SUP6,SUP9,SUPA,SUP11A**

برای دادن تلرانس برای ضخامت ها رجوع شود به جدول شماره ۱

ابعاد و اندازه میله های تخت برای فنر ها

میله های تخت برای فنر ها به دو نوع دسته بندی می شود

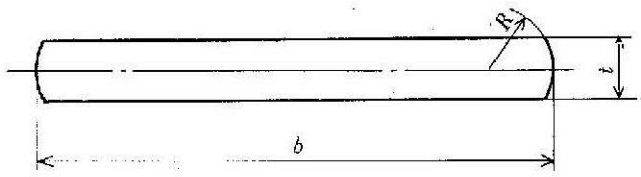
(.C hei-shu در ژاپن) و (B otsu-shu در ژاپن) ابعاد تلرانس ها طبق زیر است

مقطع برش خورده نوعB (Otsu-shu در ژاپن)

شکل مقطع برش خورده باید مطابق با شکل ۱ باشد و ابعاد واندازه ها ی تلرانس ها در جدول ۱ نشان داده شده است .

شکل ۱

Fig. 1



جدول ۱

Table 1

Unit : mm

Width		Thickness t														
		5	6	7	8	9	10	11	12	13	14	16	18	20	22	25
b	tol.	Tolerance on Thickness														
45	±0.50	±0.15	±0.15					±0.25								
50	±0.60	±0.15	±0.15	±0.18	±0.20	±0.20	±0.25	±0.25	±0.25	±0.30	±0.30					
60	±0.60	±0.15	±0.15	±0.18	±0.20	±0.20	±0.25	±0.25	±0.30	±0.30	±0.30	±0.35	±0.35			
70	±0.80		±0.18	±0.18	±0.20	±0.25	±0.25	±0.25	±0.30	±0.30	±0.30	±0.35	±0.35	±0.40	±0.45	±0.50
80	±0.80			±0.20	±0.20	±0.25	±0.25	±0.30	±0.30	±0.30	±0.30	±0.35	±0.35	±0.40		
90	±1.00					±0.25	±0.25	±0.30	±0.30	±0.30	±0.30	±0.35	±0.35	±0.40	±0.45	±0.50
100	±1.00							±0.30	±0.30	±0.30	±0.30	±0.35	±0.35	±0.40	±0.45	±0.50

توجه :۱- ضخامت ها باید در دو طرف اندازه گیری شود .و تفاوت در ضخامت طرفین باید ۲۵٪مقادیر تلرانس ضخامت گفته شده در جدول ۱ باشد .(به هر حال مینیمم مقدار باید ۰,۱ mm باشد .

۲- هر دو سطح باید کاملا صاف و به دور از هر گونه بر آمدگی باشد .

۳- مقادیر شعاع ها ی R در انتهای طرفین نامشخص است

(Hei-shu در ژاپن) (مقطع بر ش خورده نوع C)

شکل مقطع برش خورده باید مطابق با شکل ۲ باشد و ابعاد واندازه ها ی تلرانس ها در جدول ۲ نشان داده شده است .

شکل و جدول ۲

Fig. 2

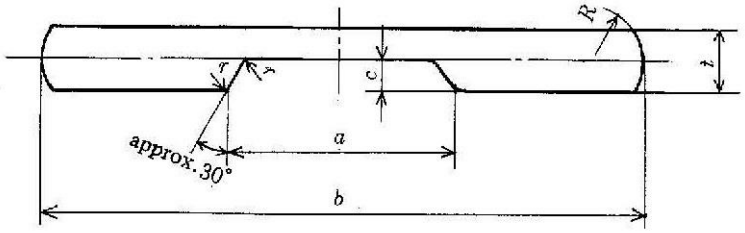


Table 2

Unit mm

Width		Thickness t				
		9	10	11	12	13
b	Tol.	Tolerance of Thickness				
70	±0.80	±0.25	±0.25	±0.25		
90	±1.00		±0.25	±0.30	±0.30	±0.30
100	±1.00				±0.30	±0.30

توجه:۱- ضخامت ها باید در هر دو رف اندازه گیری شود و تفاوت در ضخامت بین هر دو لبه باید در حدود ۲۵٪ مقادیر تلرانس ضخامت گفته شده در جدول ۲ باشد

۲- ابعاد شیار باید طبق قانون باشد

۳- مقادیر شعاع R در هر دو طرف و شعاع r در گوشه ها ی شیار نامشخص است .

۴-خروج از مرکزیت ناشی از خط مرکز شیار باید طبق قوانین **۱۰۰ ❋ ۱/۱۰۰** یا کمتر باشد .

مشخصه های اصلی فنر ها

تعاریف

.– Chamber در شکل های ۳و۴و۵ فاصله با حرف C نامگذاری شده است

— Height در شکل های ۳و۴و۵ فاصله با حرف Hنامگذاری شده

Span-- در شکل های ۳و۴و۵فاصله با حرف L نامگذاری شده

---Span at fixed end در شکل های ۳و۴و۵ فاصله با حرف L1 نامگذاری شده

شکل ۳

Fig. 3

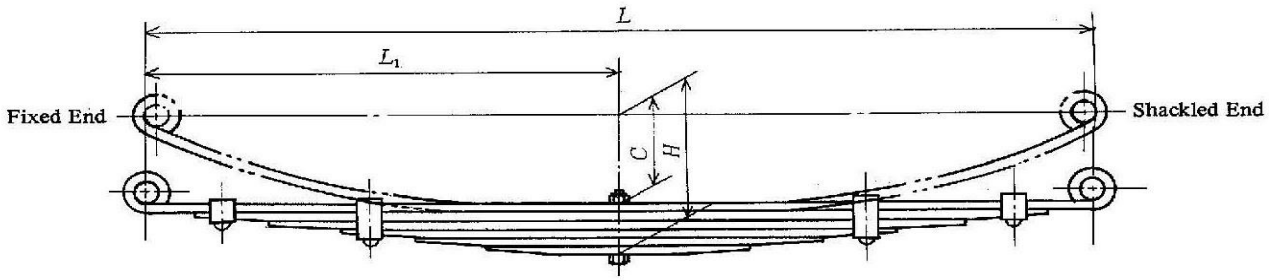


Fig. 4

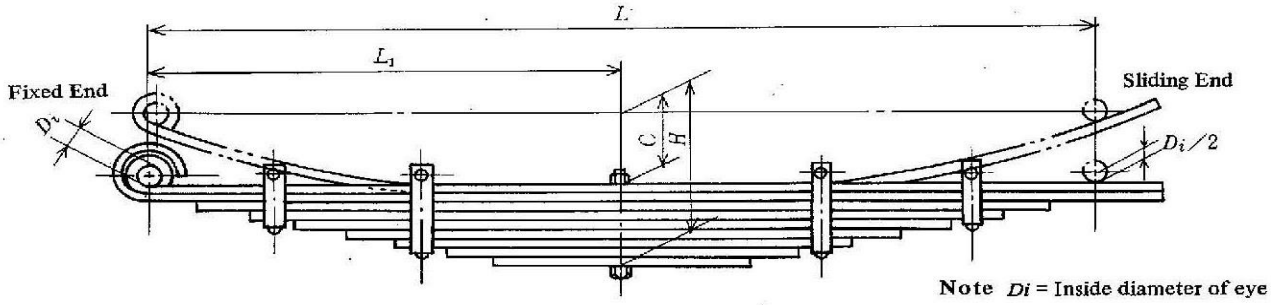
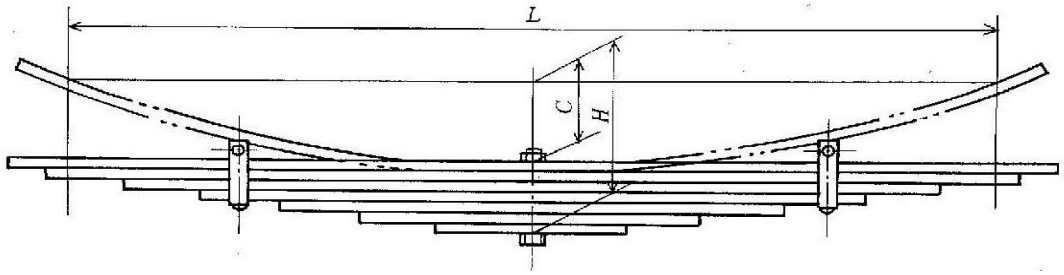


Fig. 5



Diتوجه شود که قطر داخل حلقه
مشخصات فنر اندازه گیری شده
این مشخصات طبق قوانین زیر است .

۱-بر اساس بار به کار رفته انتهای فنر باید با یک اصصکاک ناچیز تقویت شود .
۲-محفظه یا ارتفاع بار گذاری شده باید تحت شرایط بار گذاری که بار به تدریج تا نقطه اندازی گیری شده افزایش می یابد انداه گیری شود .
ثابت فنر باید از نقطه اندازه گیری شده و نقاط دیگری که به صورت توافقی مشخص شده است بدست آید .
) اندازه گیری ثابت فنر از ۲ نقطه بار گذاری شده در اطراف نفطه بار LEAF SPRING (JIS B 701مرجع : طبق اسنانداردگذاری شده طراحی شده بدست می آیند . بنابر این در مجموع ۳ نقطه بار گذاری شده باید انداه گیری شوند . به هر حال در این استاندارد ما از ۲ نقطه برای بهبود راندمان تست استفاه می کنیم .

تلرانس مر بوط به مشخصه های فنر

باید برای تلرانس گذاری از نکات ۱ تا ۵ اسفاده گردد .

۱-تلرانس محفظه تحت بار طراحی شده
که باید (2.5%+2.5mm خیز تحت بار طراحی شده باشد) که به هر حال حداقل مقدار (2.5%+2.5mm خیز تحت بار طراحی شد) باید 4mm باشد .
روش rounding –off مقادیر عددی باید بر اساس واحد ۰,۵mm طبق قوانین برای rounding –off مقادیر عددی طبق استاندارد JIS Z 8401 باشد . .

۲- تلرانس ار تفاع تحت بار طراحی شده
این باید +_(2.5%+4.5mmخیز طراحی شده) زیر بار طراحی شده باشد که به هر حال حداقل مقدار (2.5%+4.5mmخیز طراحی شده)باید 5.5mmباشد .
روش rounding –off مقادیر عددی باید بر اساس واحد 0.5 mm باشد که مطابق با استاندارد JIS Z 8401 است .

۳- تلرانس بار تحت خیز طراحی شده
این باید+_ (2.5%+2.5mmخیز طراحی شده بالا تر از بار طراحی شده باشد) * ثابت فنر طراحی شده باشد که به هر حال این حداقل مقدار (2.5%+2.5mmخیز طراحی شده) باید برابر 4mm * ثابت فنر طراحی شده باشد .

۴- تلرانس بار تحت ار تفاع طراحی شده
که این باید +_ (4mm +2.5%خیز طراحی شده بالا تر از ارتفاع طراحی شده باشد) * ثابت فنر که به هر حال این حداقل مقدار (4mm + 2.5%خیز طراحی شده) باید برابر 5.5mm * ثابت فنر طراحی شده باشد .

توجه : در موردی که مقدار تلرانس که باید کوچکتر از مقادیر مینیمم ۱ تا ۴ که منجر به یک قانون برای ارتفاع کامیون یا تفاوت در ارتفاع سمت چپ و یا راست وسیله نقلیه و غیره می شود . این مفدار باید مطابق با قراردادی که بین طرفین است باشد .

۵- دهانه فنر

دهانه باید وقتی که فنر در حالت افقی است اندازه گیری شود و تلرانس باید 3%mm_+ دهانه باشد . مشروط بر اینکه حداقل مقدار باید 3mm باشد . در مورد طراحی دهانه در انتهای ثابت تلرانس باید 3%mm_+ تلرانس دهانه در انتهای ثابت باشد مشروط بر اینکه حداقل مقدار 2mm باشد .

۶- سختی

سختی برگ بعد از گرم کردن باید 388 to 461 Hb باشد (قطر ماتریس 2.85 to 3.10 mm)
که سختی باید در کناره ها ی فشاری نزدیک مرکز ورق اندازه گیری شود .

موارد مورد نیاز به منظور فرآیند ساخت و ابعاد

تلرانس ها باید در طول ور ق و در فاصله بین مرکز سوراخ و مرکز پیش افتادگی باشد و اتنهای فنر باید فقط وقتی آنها مورد نیاز شد مشخص گردد . مقادیر باید توسط ثابت دو طرفه تعیین گردد .

ابعاد و تلرانس های مرکز سوراخ و برگ ها6-1

که این ابعاد و تلرانس های برای مرکز سوراخ و برگ ها باید مطابق با جدول ۳ و شکل ۶ باشند .

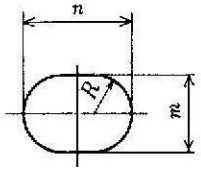
جدول۳ و شکل ۶

Table 3

Unit : mm

Dia. of Center Bolt		8	10	12	14	16
Dia. of Center Hole		$8.5^{+0.5}_{0}$	$10.5^{+0.5}_{0}$	$12.5^{+0.5}_{0}$	$14.5^{+0.8}_{0}$	$16.5^{+0.8}_{0}$
Dia. of Center Elliptic Hole of 2nd Leaf	Major Dia. *n*	$12^{+0.5}_{0}$	$14^{+0.5}_{0}$	$16^{+0.8}_{0}$	$18^{+0.8}_{0}$	$20^{+0.8}_{0}$
	Minor Dia. *m*	$8.5^{+0.5}_{0}$	$10.5^{+0.5}_{0}$	$12.5^{+0.5}_{0}$	$14.5^{+0.8}_{0}$	$16.5^{+0.8}_{0}$

Fig. 6

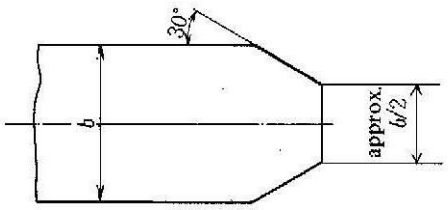


شکل های انتهای برگ6-2

شکل ها برای انتهای بریده شده در شکل شماره ۷ نشان داده شده است

شکل ۷

Fig. 7



توجه: برای یک ورق با یک نگهدارنده – انتهای مربعی – معمولا بجای انتهای بریده شده به کار می روند .
برای انتهای رول شده مخروطی و یا نوک تیز شکل نقشه ورق انتها مشخص نیست .

شکل های حلقه ها 3-6

قطر داخلی حلقه
برای بدست آوردن تلرانس قطرهای داخلی حلقه ها به جدول شماره ۴ رجوع شود .

جدول شماره ۴

Table 4

Unit : mm

Classification	Tolerance on Inside Diameter of Eye		
For those without bush or rubber bushes without external cover	Without Reaming	±0.50	
	With Reaming	A	±0.3
		B	±0.15
Metal bushes or rubber bushes with external cover	±0.15 or it shall be specified by the push-out force (the value of push-out force is subject to the agreement)		

قطر داخلی حلقه برای موارد بدون بوش یا بدون بوش های لاستیگی یا کاور خارجی که در جدول شماره ۵ نشان داده شده است .

Table 5

Unit : mm

Inside Diameter of Eye										
23	25	28	30	33	35	38	40	43	45	50

سنگ زدن عرض حلقه 4-6

در مورد طراحی سنگ زنی عرض حلقه –سایز مشخص باید کمتر از 1mm از عرض ورق کاهش یابد و تلرانس آن باید بین 0 تا -0.5 mm باشد .

شکل برگ دوم 4-6

برای بالاپوش نظامی ابعاد های اصلی باید مصابق با شکل های ۸و۹ و جدول ۶ باشد .
ابعاد های دیگر در رابطه با شکل ممکن است در طرف چپ آپشن ساخته شو د . در مورد طراحی تلرانس ویژه باید فقط محدود به ابعاد های ماکزیمم گردد . به فصاهای موجود توجه کنید

شکل ۸ و جدول ۶

Fig. 8

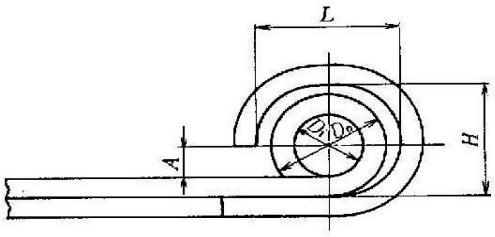
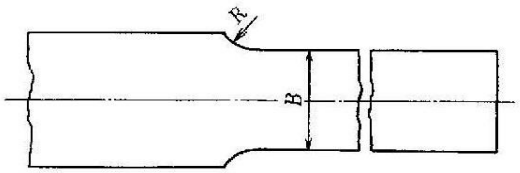


Fig. 9



R = approx. 10 mm

Table 6 Unit : mm

Leaf Width	45	50	60	70	80	90	100
B(approx)	35	40		60		75	
H(approx)	(D_0 + 3)						
L(approx)	(D_0 + 8)						
A(approx)	Di/ 2						

شکل

حلقه این ممکن است باعث بریده شدن یا قطع شدن شکل شماره ۹ شود . شکل ها و ابعاد در چنین 0.25در مورد پیچاندن درحدود مواردی باید توسط ثابت دو طرفه تعیین گردد .

موارد دیگر 5-6

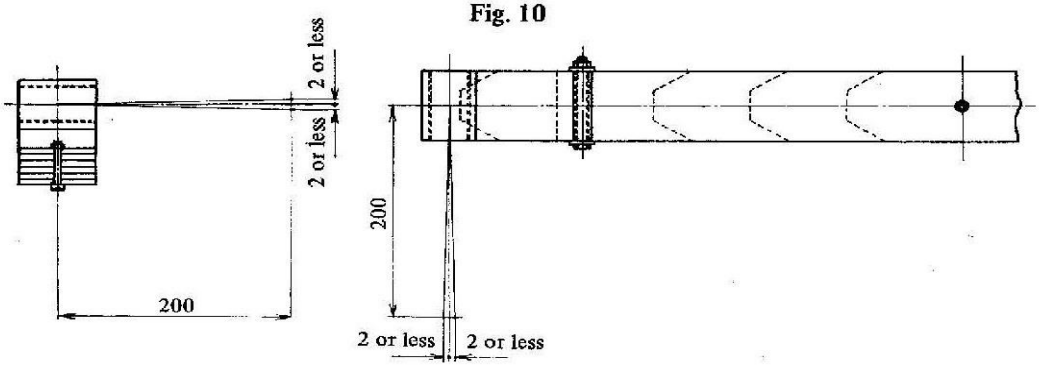
برای ابعاد های دیگر و تلرانس ها که باید طراحی شوند باید طبق جدول ۷ عمل کرد .

جدول شماره ۷ و شکل شماره ۱۰

Table 7

Item	Tolerance
Inclination of eye axis (For metal bush)	Pursuant to **Fig. 10**
Inclination of eye axis (For rubber bush)	According to agreement
Inside diameter of metal bush (When spring is completed)	H 10 specified in **JIS B 0401**
Assembled Spring Width	2.5% of leaf width between U bolts to attach springs. The width of springs with cup-center is subject to agreement

Fig. 10



CHAPTER 4

Test Procedures for Tire noise

Test Procedures for Tire Noise

1. Scope

This standard specifies the noise test procedures for tires used for automobiles. However, tires for motorcycles are excluded from the standard.

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 aims to standardize the test procedures for the tire noise, and to research and properly evaluate the tire noise as a factor of noises emitted from automobiles.

3. Kinds of Test

Coasting Test by Vehicle

The tires attached to a vehicle will be tested by coasting.

Bench Test of Single Tyre

The tire will be tested on a rotary drum.

4. Coasting Test By Vehicle

4.1 Test Site

The test site shall be a broad and flat field without influence due to sound-reflecting objects (such as hences, trees, hills, buildings etc.) that are located in the vicinity of the test site.
The test road shall be straight, flat, dry asphalt-concrete paved.
Background noise shall be at least 13dB (A) less than measured values. Further, the wind speed shall be less than 5 m/s in principle during the noise measurement.

4.2 Instrumentations

4.2.1 Sound Level Metre

A sound level metre which satisfies to **JIS C 1505** (Precision Sound Level Metre) or equivalent performance shall be used, and the weighting network shall be "A". The dynamic characteristics of the indicator shall be "Fast". Further, microphones shall be used with wind screens at the measurements.

4.2.2 Pressure Gauge

Bourdon tube pressure gauges; with the precision of equal to or more than 1.5 grade prescribed in **JIS B 7505** (Bourdon Tube Pressure Gauges), and the maximum reading equal to or less than two times the test air pressures; shall be used to measure the air pressure of the tire.

4.2.3 Instruments for Passing Time Measurement

Instruments capable to measure to 1 ms shall be used for the passing time.

4.3 Test Procedure

4.3.1 Conditions of Test Vehicle

Test vehicle shall be loaded and maintained pursuant to **JIS D 1010** (General Rules of Running Test Method of Automobiles), equipped with new tires inflated to their specified air pressure (under cold state); however, the conditions may properly be selected according to the test requirements.
Further, before the test, warming up run shall be carried to make the inflation pressure of tires stable and remove the effects of flat spotting, etc.

4.3.2 Vehicle Operation

The vehicle shall be operated in coasting, and its centre shall go along the line CC'. The coasting shall begun before the line AA' (the state of engine stopped and neutral gear) and be continued until the back end of the vehicle passes the line BB'.
Test vehicle speeds shall be 40, 60, 80, and 100 km/h. Other speeds may be added according to test requirements. Allowance of the speeds shall be ±1.5 km/h.

Applicable Standards:	**JIS B 7505**	Bourdon Tube Pressure Gauges
	JIS C 1505	Precision Sound Level Metre
	JIS D 1010	General Rules of Running Test Method of Automobiles
	JIS D 4202	Dimensions of Tires for Automobiles
Reference Standard:	**JIS D 1024**	Measurements of Noise Emitted by Automobiles

4.3.3 Location of Measuring Instruments

(1) Microphone
The microphone shall be located at the point of 7.5 m left side from the centre line CC', 1.2 m above the ground plane, and 25 m from the line AA'; and, the direction of the microphone shall be rectangular to the line CC' and parallel to the road surface.

(2) Passing Time Sensors
The sensors shall be located on the line DD' and EE', apart from the centre line CC' at least 7.5 m or more on the microphone side; and, the direction of the sensors shall be rectangular to the line CC'.

4.3.4 Measurement of Vehicle Speed

The average speed calculated from the passing time between the lines DD' and EE' in **Figure 1** shall be the test vehicle speed.

4.3.5 Measurement of Noise

The highest reading of the sound level metre while the test vehicle passes through the section between the lines AA' and BB' in **Figure 1** shall be the measured level. Measurement shall be carried out two times and the values of measured level be averaged. However, in case the difference between these two measured level exceeds 2dB (A), one more measurement shall be added and two values with less difference shall be adopted.
When the difference between the measured value and the background noise is less than 13dB (A), the value shall be corrected by **Table 1.**

Figure 1 Location of Measuring Instrument for the Coasting Test by Vehicle

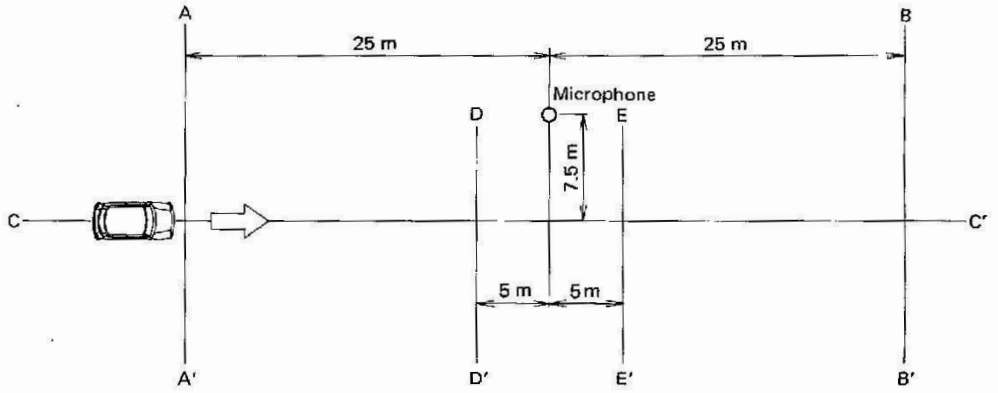


Table 1 Correction Values

Unit: dB (A)

Difference between Measurement and Background	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8~12.5
Correction Level	-3	-2.5	-2		-1.5			-1			-0.5

4.4 Record of Test Result

Test conditions and results shall be recorded into the form shown in **Attached Table 1.**

5. Bench Test of Single Tire

5.1 Test Equipment

The testing machine shall consist of a rotary drum, having a flat, coarse surface with high friction coefficient, as a substitution for road surface; and a tire loading device. The drum shall have a diametre of 3 m in principle: the test room shall be insulated so as to make the noises from the testing machine and the outside as less as possible, and be constructed not to have reflection around the testing machine excluding the floor. The reflection from the floor shall be brought as close as possible to the reflection from the surface of the drum. Further, the maximum speed shall be 110 km/h or more, and the precision of speed control be ±0.5 km/h or less. Background noise by racing of the drum shall be at least 13dB (A) less than the noise from the tire driven on the drum at each speed.

5.2 Instruments

5.2.1 Sound Level Metre

Pursuant to **4.2.1.**

5.2.2 Pressure Gauge

Pursuant to **4.2.2.**

5.3 Test Procedure

5.3.1 Test Conditions of Tire

The load and inflation pressure of the tire during the noise measurement shall be the maximum load (normal design load for the passenger car tire) and corresponding inflation pressure prescribed in **JIS D 4202** (Dimensions of Tires for Automobiles), etc. In the case, however, being prescribed by the conditions with both single and double tires, the condition with double tires shall be taken in principle.
Standard rims prescribed in **JIS D 4202**, etc. shall be used in principle.
Previous to the noise measurement, the warming up and following adjustment of inflation pressure of tires shall be carried so as to raise the measurement precision.

5.3.2 Operation

The tire shall be mounted and run on the drum, in principle, at a distance of 0.30 m between the microphone side end of the drum surface and the side end of the mounted tire.
Measurement shall be carried at 17 speeds of 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, and 110 km/h.

5.3.3 Location of Microphone

The microphone shall be located on the left side of the tire in principle, 1.00 m apart in axial direction and 0.25 m high from the centre of the contact area of the tire, and parallel with the tire axis.

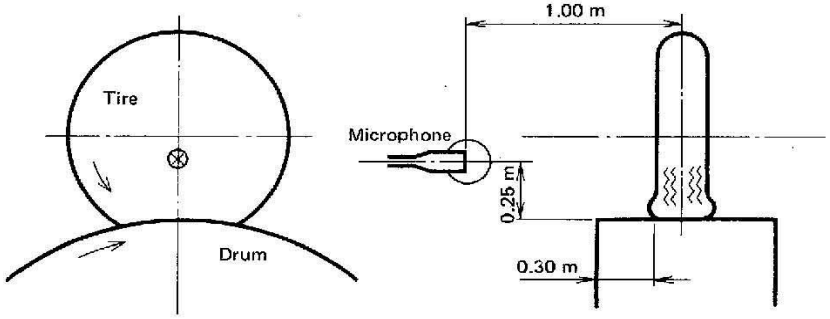
5.3.4 Measurement of Noise

Each test speed shall be continued more than 5 sec, and the central readings of the sound level metre be read. The inflation pressure shall properly be checked at each speed step change, and be kept within ±3% of the prescribed value. When the range is exceeded, measurement shall be repeated after the adjustment of the inflation pressure.
The average level of readings at five speeds around the each speed step of 40, 60, 80, and 100 km/h shall be the representative value of the tire noise.
Further, in case the difference between the measured level and the background noise is less than 13dB (A), the measurement shall be corrected according to **4.3.5.**

5.4 Record of Test Result

Test conditions and measurement results shall be recorded pursuant to the form shown in **Attached Table 2.**

Figure 2 Location of Microphone for Bench Test of Single Tire



Attached Table 1 Form of Test Record (No. 1)

Record of Tire Noise Test (Coasting)

Test vehicle (Type) : _____ Date of test : _____

Wheel arrangement : _____ Test site : _____

Load (Mass) No. of persons : _____ · kg Kind of road surface : _____

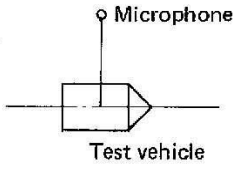
Gross vehicle weight at test : _____ kg Weather : _____

Tire Nominal size : _____ PR _____ PR Temperature : _____ °C

Make : _____ _____ Wind speed : _____ m/s

Pattern : _____ _____ Wind direction (Show by arrow) :

Others : _____ _____



Tire inflation pressure : kgf/cm²{ kPa} kgf/cm²{ kPa}

Used rim : _____ Passing time sensor : _____

Other remarks : _____ Personnel Driving : _____

Measurement (Personnel) : _____

Test Result of Tire Noise

Vehicle speed km/h	No. of measurement	Measured speed km/h	Background noise dB (A)	Sound level dB (A)		
				Measured level	Correction level	Average
40	1					
	2					
60	1					
	2					
80	1					
	2					
100	1					
	2					

Attached Table 2 Form of Test Record (No. 2)

Record of Tire Noise Test (bench)

Make of testing machine : _____

Diametre of drum : _____ m

Loading system : (Dead weight, Pressure cylinder, Screw)

Tire :

Nominal size : _____ PR

Make : _____

Pattern : _____

Others : _____

Date of test : _____

Distance between ends of drum and contact : _____ M

Tire load : kgf { N}

Inflation pressure : kgf/cm^2 { kPa}

Used rim : _____

Location of microphone : (Right · Left)

Measurement (personnel) : _____

Test Result of Tire Noise

Speed km/h	Background noise dB (A)	Sound level dB (A)		Representative value dB (A)
		Measured level	Correction level	
30				
35				
40				
45				(At 40 km/h)
50				
55				
60				
65				(At 60 km/h)
70				
75				
80				
85				(At 80 km/h)
90				
95				
100				
105				(At 100 km/h)
110				

Explanatory Note
on
JASO C 606-81 Test Procedures for Tire Noise

Explanations will be given item by item for those which require supplemental descriptions. (The numbers of items are the same with those in the Text.)

3. Kinds of Test

The tire noise, a factor of the noises emitted from the automobiles, is the level of sound generated between tires and the road surface heard from the outside of the automobiles. As the test clarifying it, there exists a method that makes a vehicle furnished with test tires coasted and measures the level of noise emitted from the vehicle (Coasting test by a vehicle). It is difficult, however, to pick up only the sound characteristics of a single tire, and the same tires may produce different result with another vehicle; therefore, "at the automobile" shall be a premise of the evaluation.
On the other hand; as the bench test method capable to research noise reduction of the tire itself, and to select the tire with less noise; there is a method to measure the sound level of the tire on a rotary drum (Bench test of a single tire).
Perfect coincidence cannot be expected between evaluating results from these two methods; the coasting test and the bench test; because of not only said substantial difference of these methods, but also abundant variating factors of the sound level itself. Appropriate selection and application of test methods in accordance with test purposes are necessary. And, as some guidelines to reduce measurement errors are mentioned in this note, we would like to continue our endeavour and incorporate its results into the standard at every chance of its revision.

4. Coasting Test by Vehicle

We adopted this method, seriously considering that the coasting does not accompanies noises from the engine, air intake- and exhaust-system; therefore, the noises generated from the tires while running may be exactly sensed, and the test results will have sufficient reproducibility.
Further, although this method is corresponding to **JIS D 1024-1967** (Measurements of Noise Emitted by Automobiles), the vehicle generating remarkable noises other than tire noise shall not be appropriate because of its low accuracy.

4.1 Test Site

As for the acoustic environment, the test site shall be as open as possible around it. An ideal place for measurement is desirable to have no obstacles within 50 m radius around the microphone, and the central area within 20 m to be asphalt-concrete paved. In reality, however, it will happen to be apart from what is called an ideal condition by following reasons;

(1) Absorption of sound by ground surface

(2) Reflection from buildings, trees, persons, guardrails, etc.

(3) Paved with asphalt-concrete but not flat ground surface, or uniformly inclined ground surface wholly in some extent of the area

(4) Softened asphalt-concrete which might affect measurements

(5) Wind

It is actually impossible to distinguish precisely each effect of these factors. However, absence of powderly snow, long grass, and soft soil or ashes is important. Further, it is desirable that the angle occupied by buildings within 50 m radius around the microphone is less than 90 degrees and there are no obstacles within 25 m radius around the test vehicle; further, effects of acoustic convergence and the place between parallel walls shall be avoided.
Although the test road is mentioned to be flat, level, and straight asphalt-concrete paved road in the Text, the fine granularity asphalt-concrete which is mostly used in actual roads should be the standard, because the tire noise is remarkably affected by the kinds and conditions of the road surface.

4.2.1 Sound Level Metre

Noises shall be measured with the sound level metre of **JIS C 1505** in A weighting network, and be evaluated by dB(A). When it is used, care shall be taken as follows;

(1) Wind screens for microphones shall have less effect on the sensitivity of sound level metres and manufacturer's guarantee.

(2) Sound level metres shall be periodically calibrated for the sake of accuracy of their indications.

4.3.1 Conditions of Test Vehicles

Confirm the place where the engine shall be stopped to put the test vehicle in perfect coasting state before the line AA' shown in **Figure 1** of the **Text**. And, prepare the vehicle not to cause afterburning between the lines AA' and BB'. The new tire means unused tire. However, after the necessary running to remove the warming up, the tire may be still regarded as a new tire. Standard of the warming up run shall be more than 45 min for truck and busses tires and 15 min for passenger car tires at 60 km/h respectively.

4.3.2 Vehicle Operation

Although, the test speeds are specified as 4 points of 40, 60, 80, and 100 km/h in the **Text**, in case of the test vehicle with the maximum speed less than 100 km/h, only the speeds measurable among said speeds are required.
Because of the strong dependence of the tire noise on the vehicle speed, allowance of the vehicle speed is limited remarkably narrow as ±1.5 km/h.

4.3.3 Location of Measuring Instruments

Location of the microphone was settled on the left side of the vehicle in the **Text**. It is due to the facts that the difference between the left and right sides of the most automobiles is not great and causes no problem, and the measurement of noise level on the left side is also sufficient from the traffic situations.
The accuracy of the location of the microphone shall be 7.5 ± 0.05 m and 1.2 ± 0.05 m.
Further, the accuracy of the distance of the sensors placed on the lines DD' and EE' in **Figure 1** of the **Text** shall be 10 ± 0.01 m.

4.3.4 Measurement of Vehicle Speed

The average speed calculated from the passing time between the lines DD' and EE' in **Figure 1** of the **Text** by following formula shall be the test vehicle speed;

$$V = \frac{36}{t}$$

where; t : passing time (s)
V : average vehicle speed (km/h)

The passing time shall be measured with the photoelectric instrument as a rule, and be read to at least 1 ms. Dousers are desirable to be used with the vehicle to improve the accuracy of measurements.
In case the other instrument than the photoelectric should be used, care shall be taken as follows;

(1) When the tape switch is used, it shall be confirmed that the noise generated by the tire stepping on the tape does not affect the measurement.

(2) When other vehicle speed measuring instrument such as the radar, and so on is used, it shall be confirmed that the instrument has equivalent accuracy with the photoelectric instrument.

4.3.5 Measurement of Noise

Measurements shall be read in the unit of 0.5dB (A). If their difference exceeded 2dB (A) after twice measurements, add one more measurement, and adopt the average of two measured values with less difference; but, in case that the third measurement comes to just middle between previous two measurements, louder two measurements shall be adopted.
Further, some sound level metre in use will happen to change its indication due to the electric source pressure, temperature, etc., therefore, the sound level metre shall be calibrated frequently.

4.4 Record of Test Result

As for the blank for wheel arrangement in **Attached Table 1**, it will be better to be filled in accordance with the guideline for description of the Automobile Specifications (published by the Society of Automotive Engineers of Japan) to make more explicit the number of tires of each axle and distinction of driving, front or rear axle.
Further, for the vehicle with complicated wheel arrangement like the connected vehicles, appropriate change may be added to **Attached Table 1**.

5. Bench Test of Single Tire

This test procedure shall be carried with a single tire, emphasizing the facts that the only tire noise, among the noises from running vehicles, is possible to be exactly picked up on the drum as the substitute of the road and measured simply and well reproducibly.

5.1 Test Equipment

(1) Specifications of the Testing Machine

As for the diametre of the drum, the greater it is, the more similar to an actual road; however, considering the size capable to be set up in test rooms and actual pervading result, 3 m was set up as the standard. Even if 3 m is difficult, it shall be greater than 1.5 times the tire diametre. As for the existing testers, other than the drum diametre, that is, drum width, loading system, resonance characteristics, etc. are not yet standardized; therefore, only the items which greatly affect to measured values were adopted in this standard. Therefore, at present, data from individual testing machine should not always be compared each other as they are.

(2) Sound Field

At the existing facilities, attached machinery around the tire, distance to the surrounding walls, sound abosrption, and sound insulating grade are different each other. On the ocasion of the test, the sound field characteristics around the tire and the microphone shall be fully examined, and improved to be nearly free sound field except the floor surface.

Floor level is desirable to be standardized 5 mm lower than the top of the drum.

(3) Drum Surface

The surface of the drum is necessary to be kept always clean, free from tread rubber refuse, oil, etc., and is standardized to have coarse surface with high friction coefficient to keep the drum surface stable, and to remove high frequency components of noise which do not appear in actual vehicle coasting. The granularity corresponding to the #50 sandpaper is desirable, and, for example, the 3M product with medium coarseness named "Safety Walk" is available.

(4) Background Noise

The difference between the background noises at the loaded driving and the unloaded idling of the drum shall not be large. Further, in case that the external background noises other than the testing machine are influential, some improvement not to change the external background noise during the test shall be necessary.

5.3.1 Test Conditions of Tire

(1) Tyre Load

In order to bring as near as possible to the actual state of being attached to the vehicle, the tire load under measurement should be the maximum load (normal design load for the passenger car tire) prescribed in **JIS D 4202**, etc. and in the case of being prescribed in both single and double tire conditions, the latter was adopted as a principle. Therefore, it may be changed, if necessary, for the tires which are not used in double, and so on.

(2) Rim

Although, it is stated that the standard rims prescribed in **JIS D 4202**, etc. shall be used, the allowable rims may be used according to the test purpose.

(3) Warming up Run

Standard of the warming up run shall be in accordance with the vehicle coasting test method.

5.3.2 Operation

(1) Location of the Tyre on the Drum

Although the location of the tire on the drum, in the direction of the width, affects the measurements each other, together with the floor condition of the test room and the location of the microphone; the distance 0.30 m between the drum and the side end of the mounted tire was set as principle, as the condition that the effects of the floor and the tire location error are small, and is desirable to existing testers. In case that 0.30 m is difficult, at least 0.10 m shall be kept.

(2) Speed

Tire noise level macroscopically is proportional to log V (where, V is the vehicle speed), but microscopically is variable by each testing machine; accordingly, evaluation at only four points, for example, of 40, 60, 80, and 100 km/h will be subject to over- or undervaluation from the characteristics of the testing machine; therefore, the moving average method was adopted. The facts, that the speed range of about 20 km/h is appropriate to be averaged, and the representative speeds will be better to be equal to those of the real vehicle coasting test, are the reasons of the prescription in the Text.

The maximum speed may be lowered in accordance with the designed specification and the purpose of use, if necessary by the kind of the tire.

5.3.3 Location of Microphone

As for the location of the microphone, the axial direction is optimum, and the distance is the longer, the better, in relation to the coasting noise of real vehicle; but the location shown in the **Text** was selected, considering the distance adaptable to the existing test facilities. However, care must be taken that the location is not a singular point of the sound field.
Further, accuracy of the location of the microphone shall be 1.00 ± 0.01 m, and 0.25 ± 0.01 m.
In case that the tire noise is remarkably different by the axial or turning direction of the tire in accordance with the tire pattern, both directions shall be measured excluding specially designated cases. Then, the direction shall be recorded.

5.3.4 Measurement of Noise

Background noises and measured values shall be read in 0.5 dB (A) units.
When the measuring method shown in **5.3.4** of the **Text** (constant speed method on the drum) can not be adopted, the method that makes the testing machine coast from a little higher speed than the maximum speed by cutting power (coasting method on the drum) may be carried.
In this method, care must be taken as follows;

(1) It is necessary to be confirmed that the method has no difference with the constant speed method on the drum.

(2) Speed and noise level shall be automatically recorded, because direct reading of the indicators will accompany great errors.

(3) It shall be clearly recorded that the coasting test on the drum was adopted.

5.4 Record of Test Result

Specifications of each facilities which seem to affect test results will be better to be recorded as follows;

(1) **Testing Machine** Diametre, width, thickness, loading system, loading direction, and suspending system of the drum

(2) **Test Room** Structure and dimentions of surrounding walls, location of the testing machine, and state of the floor

(3) **Sound Field Characteristics** Special acoustic treatment, data of sound field characteristics

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

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