SAE Seating Manual - SAE J782a

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PREFACE

At the request of the SAE Body Engineering Committee, a Seating Subcommittee was formed in 1950 at the SAE Summer Meeting at French Lick Springs, Ind.

Its purpose was to develop a seating manual that would provide a more uniform system of nomenclature, definition of functional requirements, and test methods for the various materials, components, and manufacturing methods used in automotive seating. The information compiled is for reference for body and trim engineers as well as those who work cooperatively with the engineers.

The first edition of the Seating Manual was published in 1955. It avoided the use of numbers and specific methods of test due to the fact that uniformity does not exist in the industry.

The second edition was published in 1961 with added information in certain areas that had been omitted or abbreviated in the first Manual. An effort was made to offer suggested values, wherever possible, not as a standard but as a test value in the range of current accepted practice.

This third edition of the Manual was prepared to give due recognition to technological advances and changes which have been made in automotive seating, as in the case of previous editions.

Chapter 1
MOTOR VEHICLE SEATS

1.1 FRONT SEATS

The motor vehicle seat is a structure engineered to comfortably seat the driver and passengers for short, as well as extended, periods of time with a minimum of fatigue. It must position driver and passengers at their proper locations to assure the desired:

(a) Proximity of driver to steering wheel and other controls.

(b) Field of vision.

(c) Head room.

(d) Leg room.

In addition, modern automotive seating requires an appearance which meets the stylist's requirements and, in many cases, versatility, such as folding for entrance or egress. Today's seating may encompass such things as reclinable seat backs, arm rests and/or head rests of the built-in or add-on variety.

A number of typical motor vehicle seats are shown in Fig. 1-1.

1.2 REAR SEATS

The rear seats may take many different shapes; the most basic seats are the 4-door, 2-door, and station wagon seats. In general, 4-door and 2-door seats are supported by the floor pan and are not adjustable. Seats may be side-facing, front-facing, or rear-facing. Most station wagon seats fold to give a level loading area.

A number of typical rear seats are shown in Fig. 1-2.

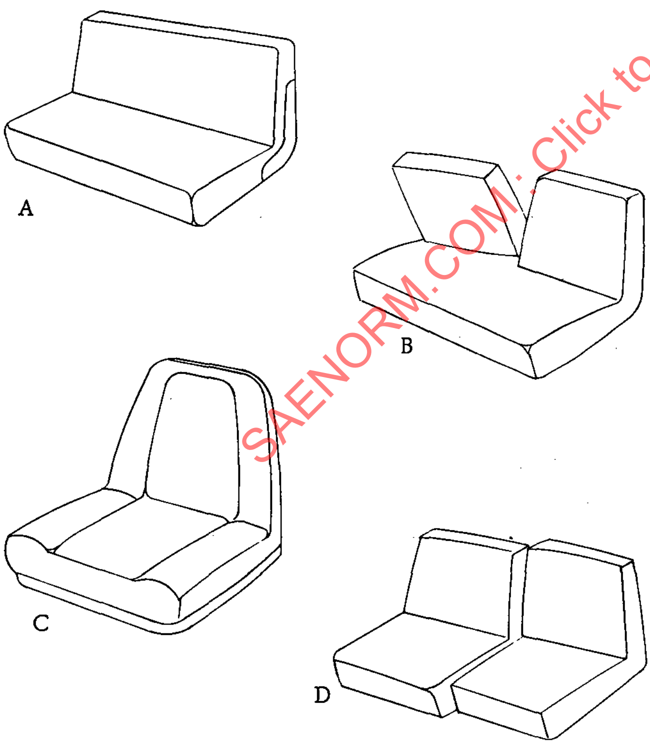


Fig. 1-1 - Typical front seats
A- Bench seat
B - Bench seat - split back
C - Bucket seat
D - Individual adjustable seat

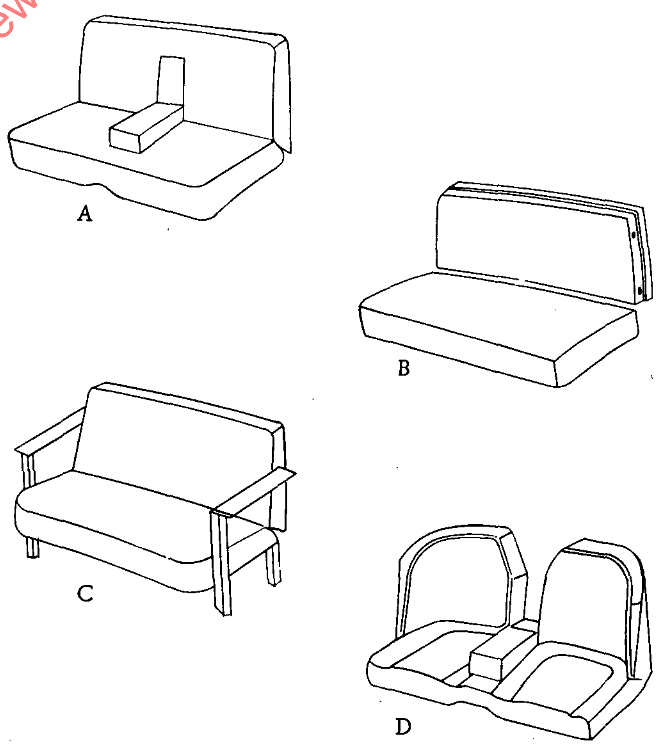


Fig. 1-2 - Typical rear seats
A - Seat with folding arm rest
B - Folding seat for cargo space
C - Fixed seat
D - Contoured seat with folding arm rest

Chapter 2
SEAT ADJUSTERS

2.1 DEFINITION

A seat adjuster is a device which, when suitably anchored to the vehicle structure, supports the seat frame assembly and provides adjustments by physical or mechanical means.

2.2 PURPOSE

The purpose of a seat adjuster is to enable the driver to readily adjust the seat position to suit his individual requirements.

2.3 DESIGN REQUIREMENTS

2.3.1 The usual adjustment range fore and aft is between 3-1/2 and 6 in., in increments of about 1/2-5/8 in., or an infinite number of positions as in the case of the power-operated adjuster.

2.3.2 The usual range of maximum vertical adjustments is between 1-1/4 and 2-1/2 in., in increments of about 1/4 in., or an infinite number of positions as in the case of the power-operated adjuster.

2.3.3 The usual range of angular adjustment is between 5 and 10 deg from the horizontal plane, in increments of about 1/2 deg, or an infinite number of positions as in the case of the power-operated adjuster.

2.3.4 The adjuster should provide a safe locking device which should not fail under normal operation. Impact loadings should also be considered.

2.3.5 It should operate with minimum effort.

2.4 TYPES OF ADJUSTERS

2.4.1 A two-way straight adjuster, providing level fore-and-aft movement of the seat (Fig. 2-1).

2.4.2 A two-way inclined straight adjuster combining the elevation with forward movement of the seat (Fig. 2-2).

2.4.3 A two-way curved adjuster combining forward tilt and elevation with forward movement of the seat (Fig. 2-3).

2.4.4 A four-way elevating adjuster consisting of a mechanism for independently raising the seat in addition to the fore-and-aft movement of the basic type adjusters. (See Figs. 2-1 - 2-3.) The vertical elevation is sometimes combined with a movement tilting the seat forward as it is raised (Fig. 2-4).

2.4.5 A multipositioning adjuster provides the seat with angular tilting and elevating as well as any combination of these and the normal fore-and-aft movements (Fig. 2-5).

The coordination of the movements between the right-hand and the left-hand seat adjusters may be accomplished

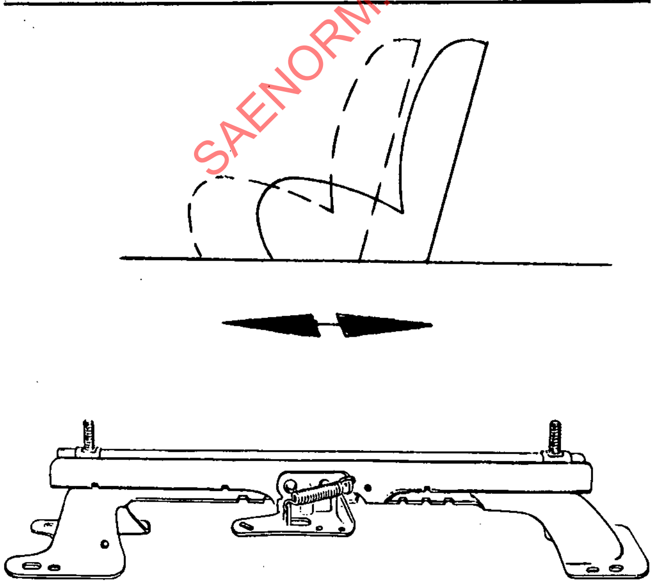


Fig. 2-1 - Two-way straight adjuster

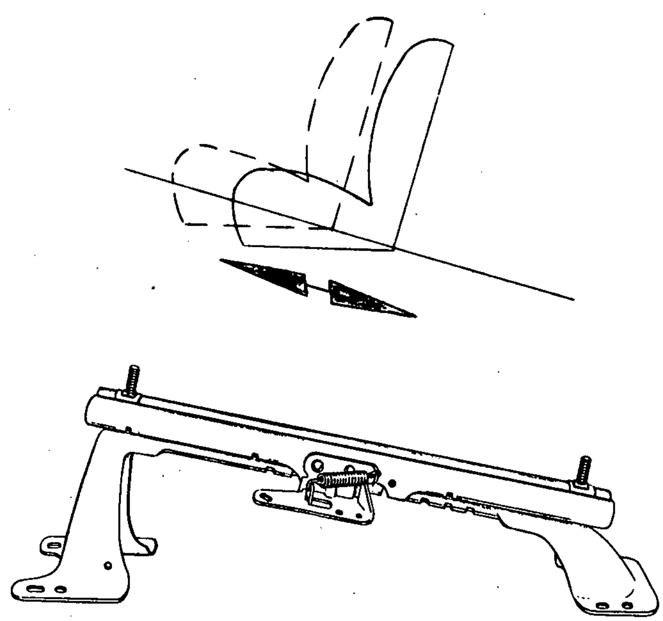


Fig. 2-2 - Two-way inclined straight adjuster by torque bars, cables, seat frame, or some other mechanical interlocking device so that whatever motion is imparted to one side of the seat is transmitted to the opposite side.

2.5 METHODS OF TEST

2.5.1 GENERAL REQUIREMENTS

2.5.1.1 Manual Seat Adjusters - The seat adjuster mechanism must be capable of giving trouble-free operation throughout the design range of travel. The locking mechanism should operate with the application of no more than 15 lb to the release. Adequate structural strength must be provided to sustain vertical and lateral loading. Ease of operation is essential and forces required to operate the seat should not exceed 80 lb in the rearward direction and 20 lb in the forward direction.

2.5.1.2 Power Seat Adjusters - Power seat adjusters, in addition to the requirements in paragraph 2.3, should be capable of traveling in a fore-and-aft direction at the rate of 0.4-1.0 in./sec. with a load of 700 lb and should be capable of raising a 600-700 lb load at 70 F.

2.5.2 OPERATION TEST

2.5.2.1 Manual Seat Adjusters - For this test, the seat adjuster is mounted in car position with a seat frame or equivalent structure and loaded to 156 lb per passenger, properly distributed, in addition to the normal weight of the seat. A mechanism to cycle the seat adjuster between the extremes of its travel must be provided. The locking mechanism may be activated if desired. The seat is operated 5000-10,000 cycles with periodic inspection for wear during the cycling test. The periodic inspection normally consists of an examination of the wearing surfaces and measurements of the force required to move the adjusters and the locking mechanism control. A suggested procedure for conducting this test is shown in Fig. 2-6.

2.5.2.2 Power Seat Adjusters - Power seat adjusters are normally set up and loaded in a manner similar to the manual seat adjusters and operated through the extremes of travel on a cyclic basis, such as forward, up, rearward, and down for 5000-10,000 cycles. Time delays are ordinarily required between each change of direction of motion in the cycle to prevent the overheating of the drive mechanism. Periodically during this test, the adjuster is examined for wear and operating characteristics, such as the time of cycling, power

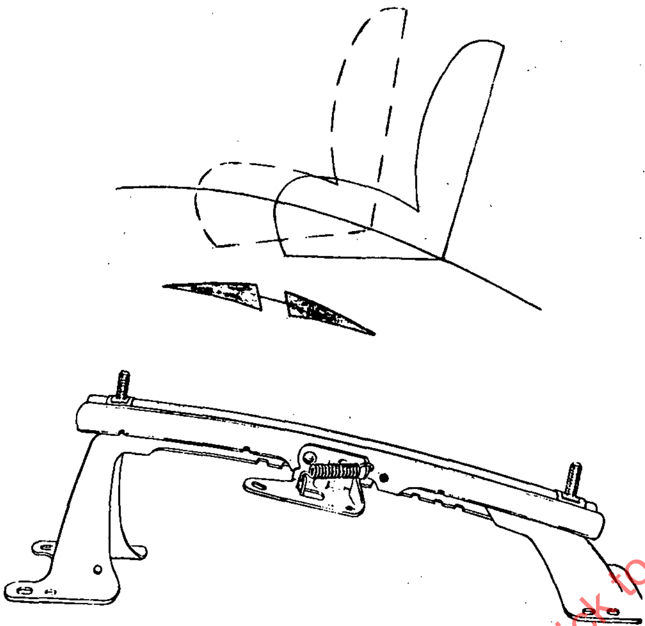


Fig. 2-3 - Two-way curved adjuster

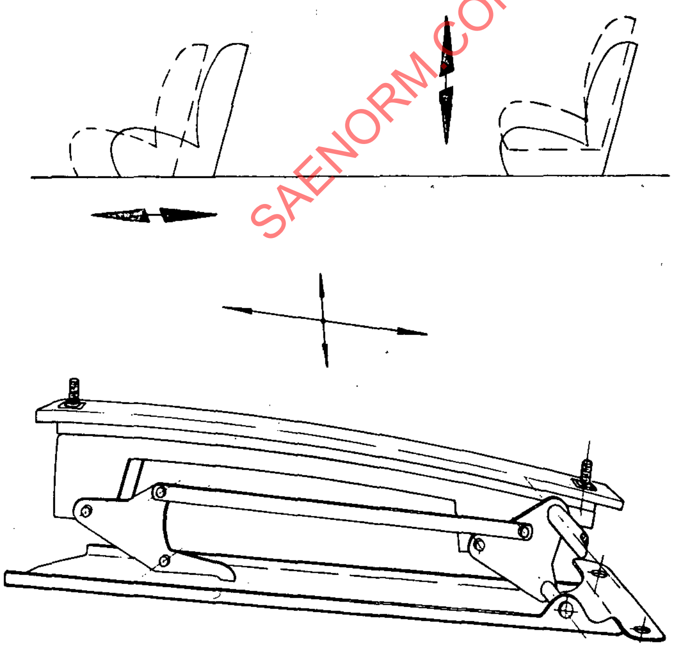


Fig. 2-4 - Four-way elevating adjuster

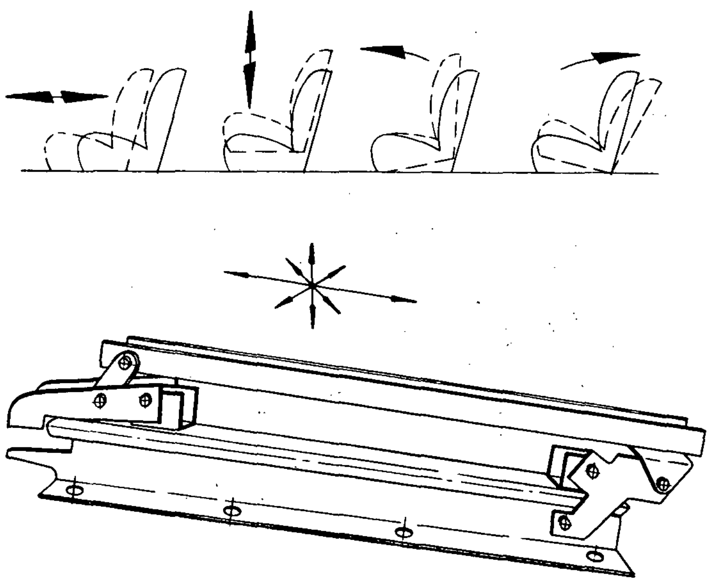


Fig. 2-5 - Six-way adjuster

requirements, etc. Measurement of power is ordinarily a good indication of the wear characteristics in testing a power seat adjuster.

2.5.3 STATIC TEST

2.5.3.1 Manual and Power Seat Adjuster - Static tests on seat adjusters are normally of the proof load type. Adjusters are not required to be operable after proof loading, but must have no permanent separation of mating parts, per SAE J879. These tests are conducted with manual seat adjusters in their extreme positions and power seat adjusters 1/4 in. short of the extreme positions.

The tests are:

(a) Vertical Loading - A vertical load of 500 lb per passenger is applied to seat frame. Indicators installed to determine the relative movement of the seat adjuster to the base under this load application (Fig. 2-7).

(b) Rearward Back Loading - The specifications for rearward back load are outlined in SAE J879.

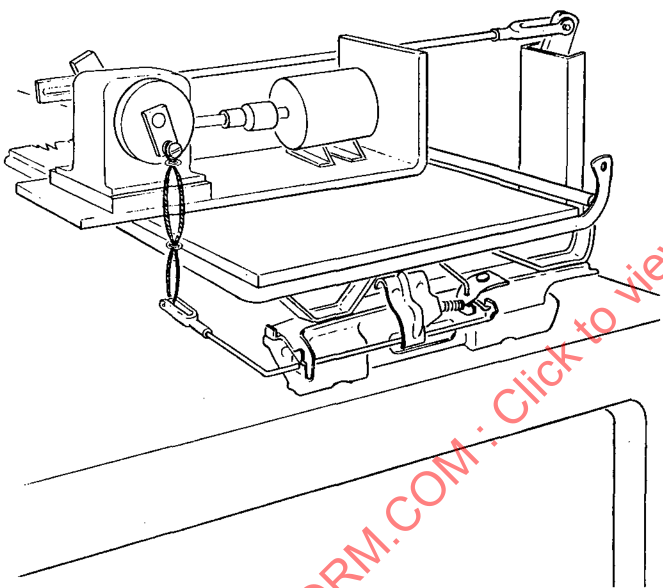


Fig. 2-6 - Operation test of seat adjuster

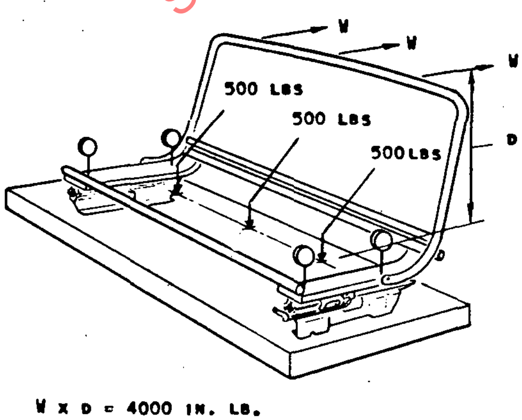


Fig. 2-7 - Static vertical load test of seat adjuster

(c) Lateral Loading - A lateral load of 100 lb is applied midway between the seat frame attachments, and corresponding measurements are taken at the seat frame attachment relative to the base. The load is applied first to the left and then to the right, giving the total displacement on the indicators. Typical setup is shown in Fig. 2-8. This test is conducted with no vertical load on the seat frame.

(d) Fore-and-Aft Chucking Load - A load of 100 lb is applied in both the fore-and-aft direction at the center of the seat frame, and measurements of the fore-and-aft movement of the seat adjuster slide are made relative to the base. Deflections for this loading should be a minimum to avoid noise and chuck problems. A typical setup for this test is shown in Fig. 2-9.

2.5.4 OTHER MISCELLANEOUS TESTS - Other tests are conducted for specific studies on seat adjusters. However, these tests are not ordinarily performed in all instances. It is sometimes desirable to study the brinelling characteristics of the rollers or balls by subjecting the seat to a vibration test.

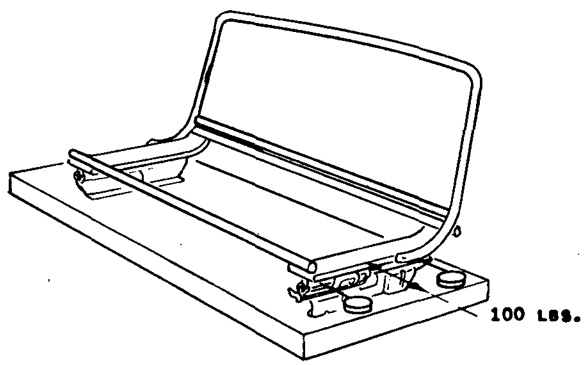


Fig. 2-8 - Static lateral load test of seat adjuster

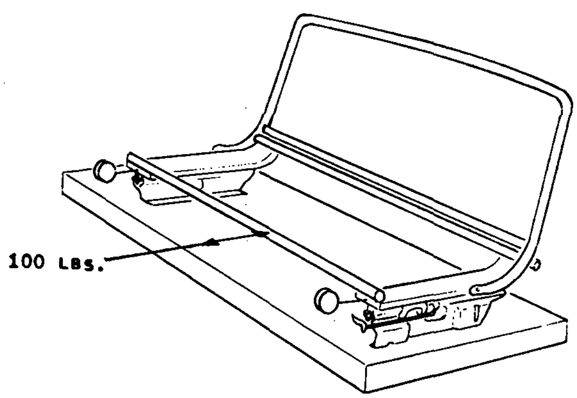


Fig. 2-9 - Static fore and aft chucking test of seat adjuster

Chapter 3
MOTOR VEHICLE SEAT FRAMES

3.1 DEFINITION

The term "seat frame" refers to the structural portion of a seat assembly. The frame may be constructed with springs attached directly to the structural frame or with springs attached as a separate assembly.

3.2 PURPOSE

The purpose of the seat frame is to supply shape and support for the cushioning members. It also provides an attachment directly to the vehicle structure or indirectly through adjuster and/or other miscellaneous parts.

3.3 TYPES OF SEAT FRAMES

3.3.1 FRONT SEAT FRAMES

3.3.1.1 Full Width Cushion - Full width back (Fig. 3-1).
3.3.1.2 Full Width Cushion - Split back (Fig. 3-2).
3.3.1.3 Individual Cushion and Back (Fig. 3-3).
3.3.1.4 Reclining Seat Frame (Figs. 3-4 and 3-5).

3.3.2 REAR SEAT FRAMES

3.3.2.1 Full Width Cushion - Full width back (Fig. 3-6).
3.3.2.2 Full Width Cushion - Split back (Fig. 3-7).
3.3.2.3 Folding Seat (Fig. 3-8).

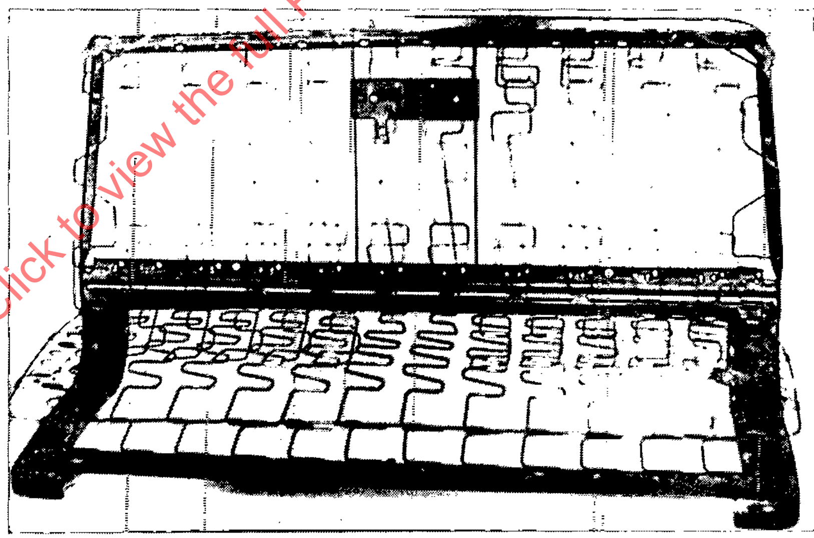


Fig. 3-1

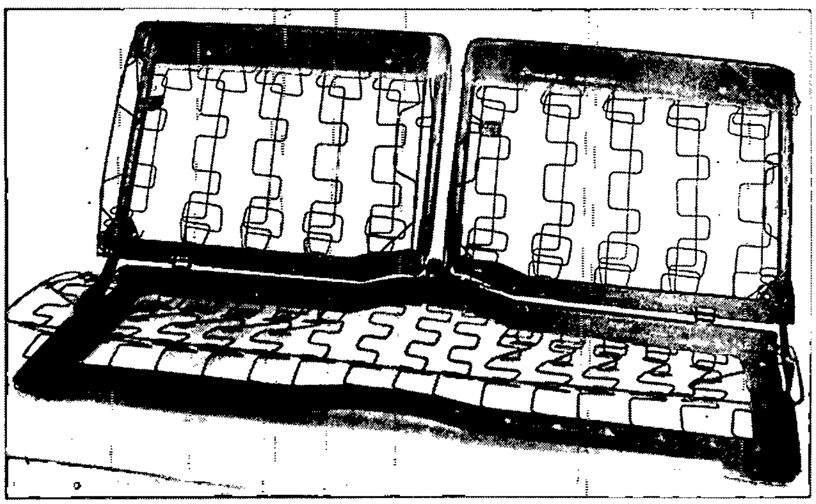


Fig. 3-2

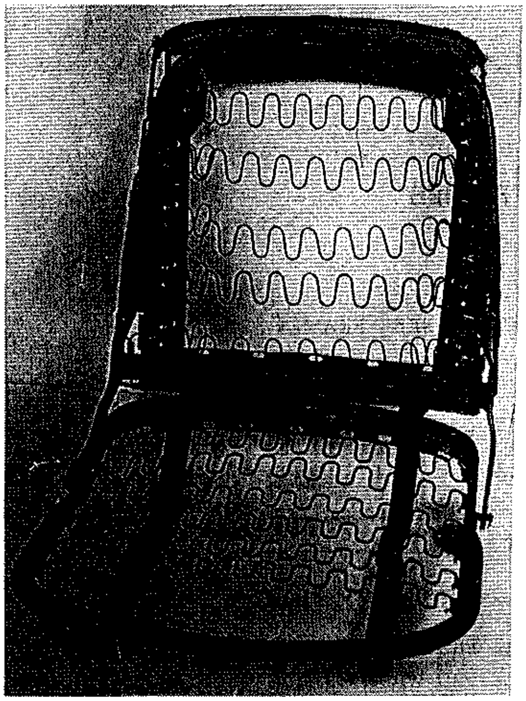


Fig. 3-3

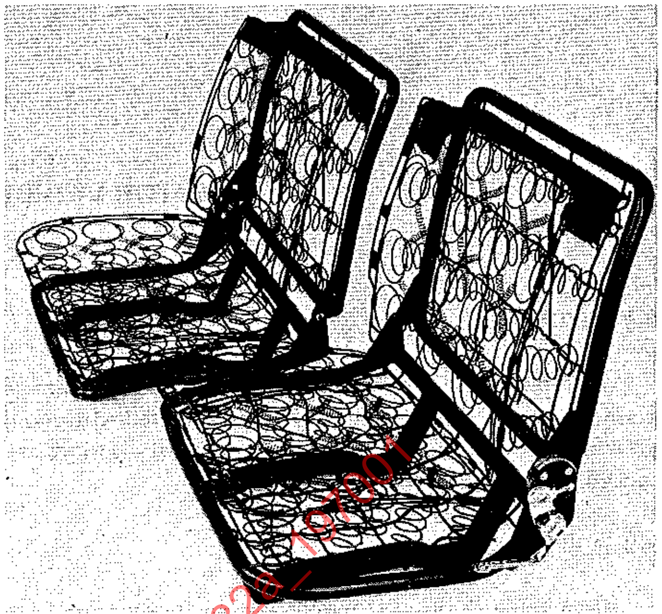


Fig. 3-5

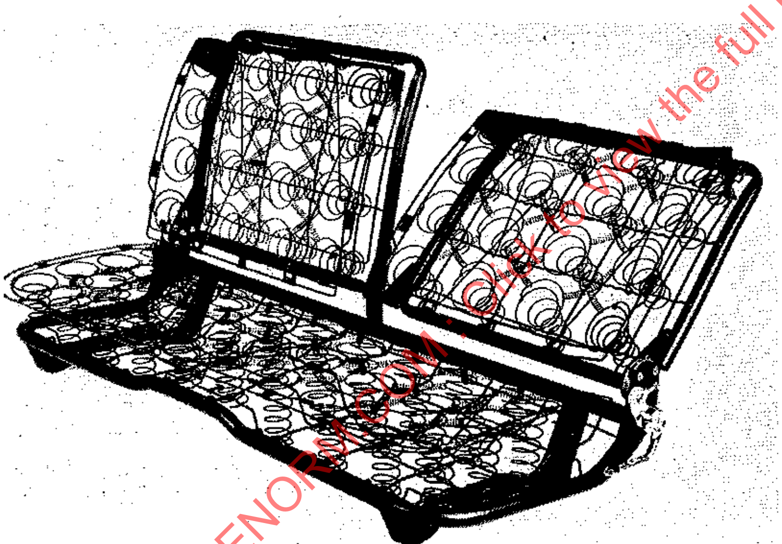


Fig. 3-4

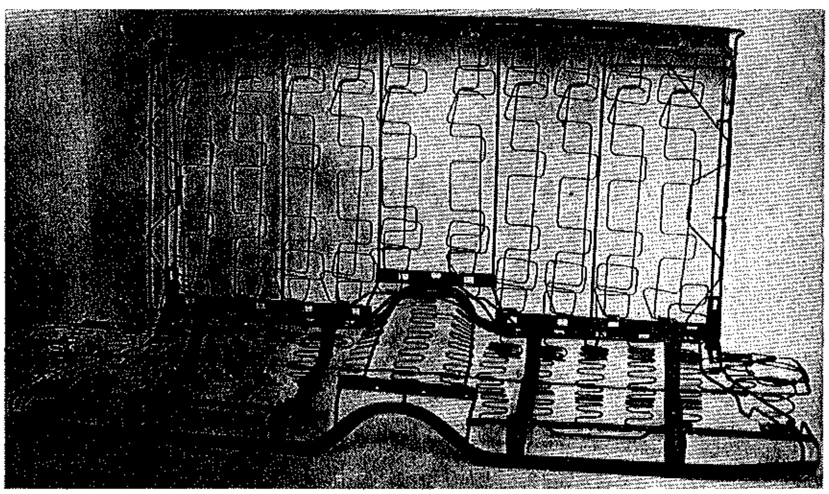


Fig. 3-6

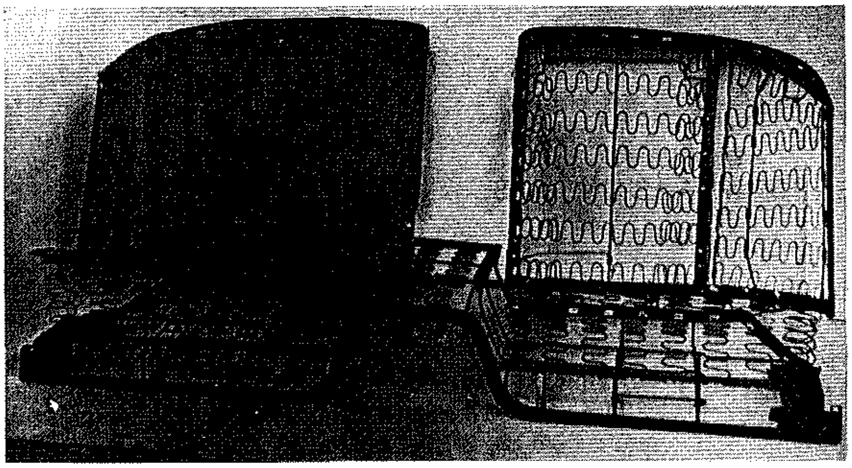


Fig. 3-7

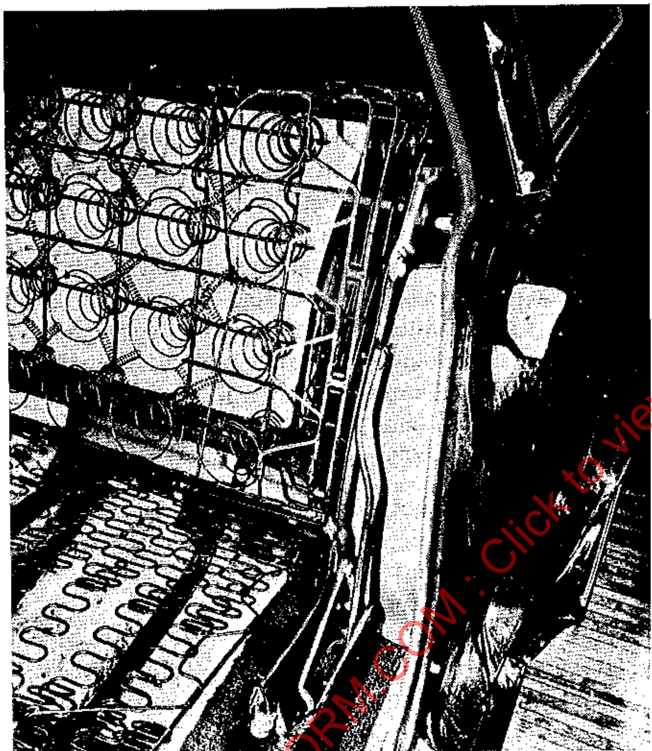


Fig. 3-8

3.4 STRUCTURAL CLASSIFICATIONS

The frames are generally classified structurally as follows:

(a) Tubular.
(b) Stamped or rolled.
(c) Wire or sheet metal assemblies.
(d) Wood.
(e) Combination of above.

3.5 DESIGN REQUIREMENTS

3.5.1 Structurally the seat frame should be strong enough to withstand the design load requirements without excessive permanent set. (See paragraph 3.6.) The load requirements vary with the number of passengers and vehicle use.

3.5.2 The seat frame is constructed to provide a means of attaching trim, ornamentation, and accessories.

3.6 METHODS OF TEST

Seat frames are subjected to a variety of tests; these are outlined in the SAE J879. In addition to the tests shown in SAE J879, other tests for fatigue, shear rigidity, etc., are sometimes performed for specific investigations.

Chapter 4
SEAT SPRING ASSEMBLIES

4.1 DEFINITION

A seat spring assembly is that part of a seat which distributes the load of the occupant to a seat frame or substructure mounted on or within a seat frame or other structural member.

4.2 PURPOSE

The purpose of the seat spring assembly is to absorb shock and vibration and support the occupant with a maximum of comfort and safety.

4.3 DESIGN REQUIREMENTS

Seat cushion and back spring assemblies are designed within the limitations of the body. This accounts for the many variations and combinations. The basic requirements of a good seat spring assembly are as follows:

(a) It should support the occupant.

(b) It should provide comfortable pressure distribution.

(c) It should have acceptable service life and minimum set.

(d) It should be noiseless.

(e) It should have good dampening characteristics to absorb shock and vibrations.

(f) The outside edges of the spring assembly should provide sufficient support to hold the occupant and maintain the trim contour.

4.4 SPRING ELEMENT TYPES

4.4.1 ZIGZAG AND FORMED WIRE TYPE SPRING ELEMENTS

4.4.1.1 Definitions and Terms - The zigzag and formed wire spring element provides a load-supporting span by being formed (two-dimensionally) into a ribbon-like flat pattern which is anchored at or near each end. Spring action results from the twist of the torsion bars and the flexing of the radii joining them. Additional springing results from crowning the ribbon element, high near the middle. However, the most pronounced spring action is created when bends are placed in the surface near the front (and sometimes rear).

(a) Zigzag Springs - The wire is formed into a pattern of constant width having parallel bars connected by constant radii which are alternating. Common terms to define sections of the spring are:

(1) Convolution - The distance from any one point on the spring to the next corresponding or exact same point in the series of formations making up the spring (Fig. 4-1).

(2) Bar - The center, or straight portion, of the formation making up the spring (Fig. 4-1).

(3) Loop - The outer, curved portion of the formation making up the spring (Fig. 4-1).

(b) Formed Wire Spring Elements - The wire is formed into a flat ribbon having nonuniform torque and spacer bars connected by radii (Fig. 4-2). Commonly used terms to define sections of the spring are:

(1) Torque Bar (Transverse Bar) - That section of wire lying in a transverse direction to the longitudinal axis of the formation which, when deflected, has a torsional action under load.

(2) Spacer Bar (Longitudinal Bar) - That section of wire lying parallel to the axis of the formation.

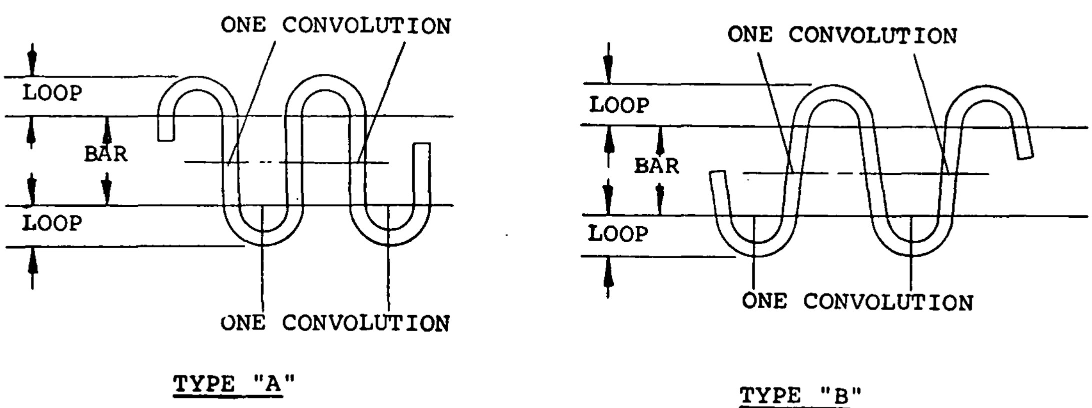


Fig. 4-1 - Zigzag configuration

4.4.1.2 Curvature

(a) Zigzag spring elements can be readily fabricated with a predetermined constant arc or crown.

(b) Formed wire spring elements are fabricated flat, and arc or crown is obtained by kinking spacer bars or twisting torsion bars.

4.4.1.3 Profiling - The zigzag and formed wire spring element ribbon is bent at the front (and sometimes rear) by twisting one or more torsion bars about their axis.

4.4.1.4 Assembly - Successive rows of nearly parallel zigzag and/or formed wire spring elements are mounted one after another and interconnected to form the assembled load-supporting surface. Component connecting parts are clipped to loops, spacer, and torsion bars of successive spring elements.

4.4.1.5 Description of Units - Zigzag or formed wire springs are classified by their usage and location in the assembly. The major classifications are back and cushion. These are subdivided into main and supporting, and can further be described as to profile, number, and types of bends. All units are described as being in car position. Typical zigzag or formed wire spring would, therefore, be described as:

(a) Main back spring with double "V" or fishmouth at both ends (Fig. 4-3A).

(b) Main cushion spring with a spacer and fishmount or "V" bend in front and an obtuse bend in the rear (Fig. 4-3B).

(c) Side cushion support spring with fishmouth or three "V" bends (Fig. 4-3C).

(d) Back support spring with fishmouth or two "V" bends (Fig. 4-3D).

4.4.1.6 Material - Steel manufactured by the open hearth or electric furnace process and cold drawn to develop the desired mechanical properties is generally used for zigzag or formed wire springs.

Commonly used gages and suggested tensile ranges for zigzag and formed wire are listed in Table 4-1. A stress relief operation on the final formed element is required. Temperature, time, and method are determined by application.

4.4.2 COIL TYPE SPRINGS

4.4.2.1 Definition - A coil-like spiral formation of tempered wire rolled into numerous configurations as illustrated in (Fig. 4-4).

4.4.2.2 Assembly - Individual coil springs are assembled to form a load-supporting surface by hog ringing, clipping, or interlacing the coil bottom turn to the frame, and hog ringing, clipping, and helical cross-tying the coil top turn to adjacent components. Some loose end coils are placed

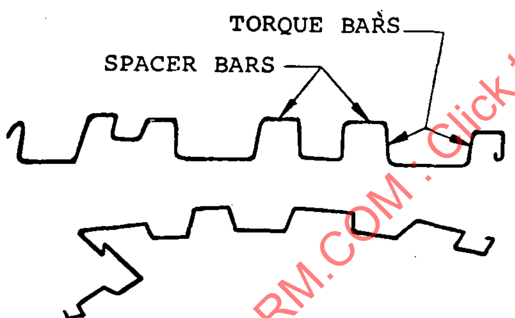


Fig. 4-2 - Formed wire spring

Table 4 - 1

W & M Gage	Nominal Diameter, in.	Suggested Tensile Range, psi in thousands
8	0.162	180-210
8-1/2	0.155	190-220
9	0.148	200-230
9-1/2	0.142	200-230
10	0.135	205-235
10-1/2	0.128	205-235
11	0.120	210-240
11-1/2	0.113	210-240
12	0.105	215-245
12-1/2	0.099	215-245
13	0.091	220-250

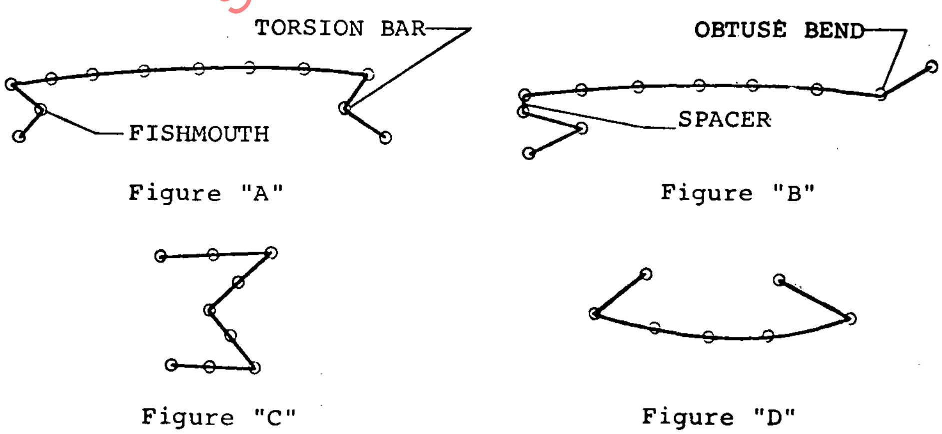


Fig. 4-3 - Types of zigzag or formed wire profiles in pockets sewn in muslin (burlap) strips and successive rows of encased coils are hog ringed to adjacent rows at the top and to basic wire at the bottom. All coil spring assemblies are held in place with a peripheral top and bottom rim wire.

4.4.2.3 Material - Steel manufactured by the open hearth or electric furnace process and cold drawn to develop the desired mechanical properties is used for coil springs. (See Table 4-2.) A stress relief operation on the final formed element is required. Temperature, time, and method are determined by application

4.4.3 JACK STRINGER (FLEXIBLE BASE ELEMENT)

4.4.3.1 Definition - A jack stringer is a formed piece of wire which acts as a flexible base element to which coils are mounted (Fig. 4-5).

4.4.3.2 Assembly - Jack stringer elements are mounted to a substructure by clipping or other means as required.

4.4.3.3 Material - Steel manufactured by the open hearth or electric furnace process and cold drawn to develop the desired mechanical properties is used for jack stringers. (See Table 4-3.) A stress relief operation on the final formed element is required. Temperature, time, and method are determined by application.

4.5 COMPONENT PARTS OF HARD DRAWN WIRE

4.5.1 STABILIZER BRACE

4.5.1.1 Definition - That unit connecting one surface with another to stabilize or give support to surface (usually a wire used in compression or tension). (See Fig. 4-6.)

4.5.1.2 Material - Steel manufactured by the open hearth or electric furnace process and cold drawn to develop the

Table 4 - 2

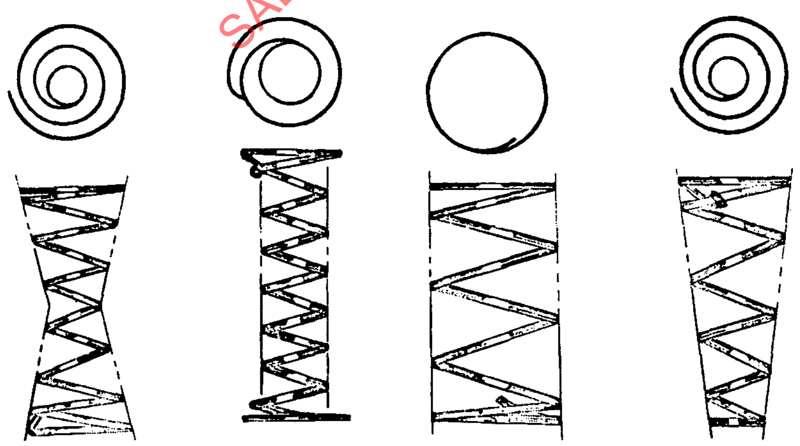
W & M Gage	Nominal Diameter, in.	Suggested Tensile Range, psi in thousands
9	0.148	185-215
10	0.135	190-220
10-1/2	0.128	190-220
11	0.120	195-225
11-1/2	0.113	195-225
12	0.105	200-230
12-1/2	0.099	200-230
13	0.091	210-245
14	0.080	225-260
15	0.072	230-265
16	0.062	235-270
17	0.054	240-280
18	0.047	245-285

Fig. 4-5 - Jack stringer

Table 4 - 3

W & M Gage	Nominal Diameter, in.	Suggested Tensile Range, psi in thousands
6	0.192	170-200
7	0.177	175-205
8	0.162	180-210

Fig. 4-6 - Stabilizer brace



A - Spring, hour glass back and cushion construction

B - Spring, spool back and cushion construction

C - Spring, cylinder

D - Spring, cone

Fig. 4-4 - Configurations of spiral wire formations desired mechanical properties. (See Table 4-4.) A stress relief operation on final formed element is required. Temperature, time, and method are determined by application.

4.5.2 BORDER WIRE

4.5.2.1 Definition - That unit which defines the perimeter and shape of the spring assembly and serves to connect individual spring elements into an integrated unit. Descriptive adjectives may be used to designate specific uses and locations, such as upper, lower, single, double, etc. The wire may be round or flattened as desired, as shown in Fig. 4-7.

4.5.2.2 Material - Same as stabilizer brace.

4.5.3 ARCH WIRE

4.5.3.1 Definition - A supplemental support used in conjunction with the border wire. An arch wire may be used to support padding as well as the border wire itself (Fig. 4-8).

Table 4 - 4

W & M Gage	Nominal Diameter, in.	Suggested Tensile Range, psi in thousands
7	0.177	160-190
8*	0.162	165-195
9*	0.148	165-200
10	0.135	170-205

*8 and 9 gages may be roll flattened to finished sizes 0.095 × 0.210 in. and 0.082 × 0.197 in., respectively. Tensile strength increases by approximately 10,000 psi.

Fig. 4-7 - Border wire

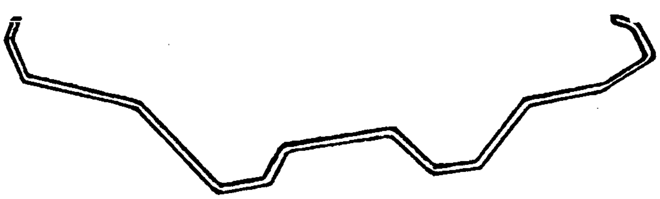


Fig. 4-8 - Arch wire

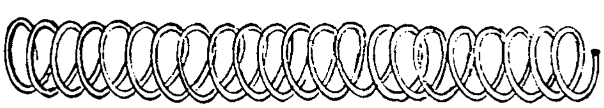


Fig. 4-9 - Helical coil tie spring

4.5.3.2 Material - Same as stabilizer brace.

4.5.4 HELICAL COILS (CLOSE OR OPEN WOUND)

4.5.4.1 Definition - Used to bridge between coil spring elements or to lace elements into an integrated spring assembly (Fig. 4-9).

4.5.4.2 Material - Steel manufactured by the open hearth or electric furnace process and cold drawn to develop the desired mechanical properties (Table 4-5).

4.5.5 LOOP TIES (HAIR PINS)

4.5.5.1 Definition - A formed piece of wire for stabilizing or tying spring units together (Fig. 4-10).

4.5.5.2 Material - Hard drawn steel wire made by the open hearth or electric furnace process (Table 4-6.)

4.6 MISCELLANEOUS COMPONENT PARTS

4.6.1 HOG RINGS

4.6.1.1 Definition - A wire clip used to fasten listings to border wire, coils, or other miscellaneous parts (Fig. 4-11).

4.6.1.2 Material - Low carbon steel wire made by the open hearth or electric furnace process (Table 4-7).

4.6.2 CLIPS

4.6.2.1 Definition - A preformed piece of metal used to attach spring elements or component parts together (Fig. 4-12).

4.6.2.2 Material - Low carbon cold rolled strip steel (SAE 1010).

Table 4 - 5

W & M Gage	Nominal Diameter, in.	Suggested Tensile Range, psi in thousands
18	0.047	215-255
19	0.041	220-260
20	0.035	220-260

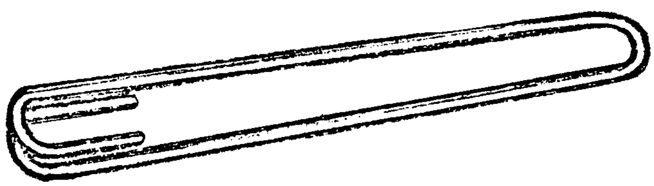


Fig. 4-10 - Loop tie

Table 4 - 6

W & M Gage	Nominal Diameter, in.	Suggested Tensile Range, psi in thousands
14	0.080	225-260
15	0.072	230-265

W & M Gage	Nominal Diameter, in.	Suggested Tensile Range, psi in thousands
14	0.080	100-125
15	0.072	100-125
16	0.062	100-125

Table 4 - 7

Fig. 4-11 - Hog ring

4.6.3 SPRING RETAINERS

4.6.3.1 Definition - Sheet metal of a preformed shape used to stabilize, locate, or hold spring elements in a definite position (Fig. 4-13).

4.6.3.2 Material - Usually a low carbon steel with gage and type as specified by ultimate user.

4.6.4 LISTINGS

4.6.4.1 Definition - A flexible member used to restrict or space spring units and/or support padding (Fig. 4-14).

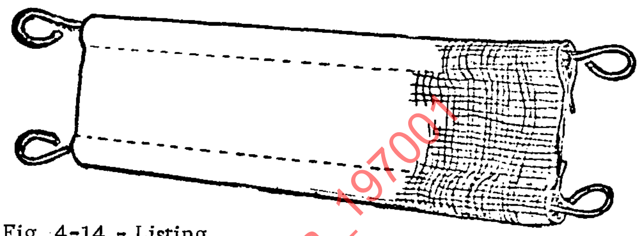
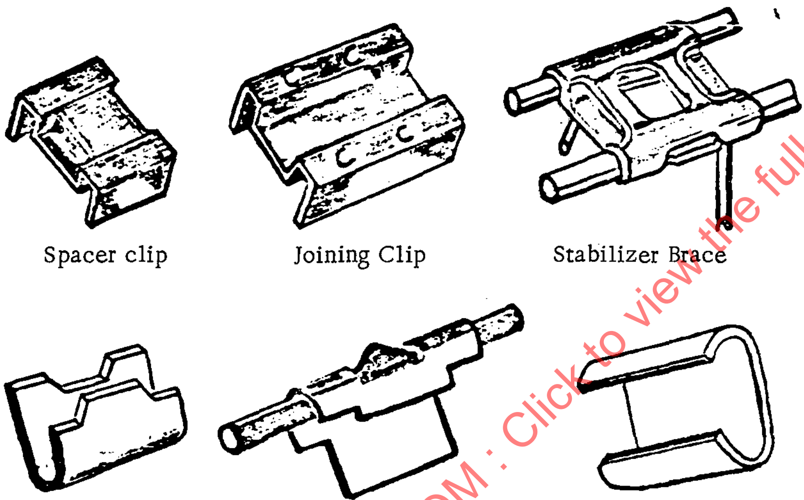


Fig. 4-14 - Listing



Spacer clip

Joining Clip

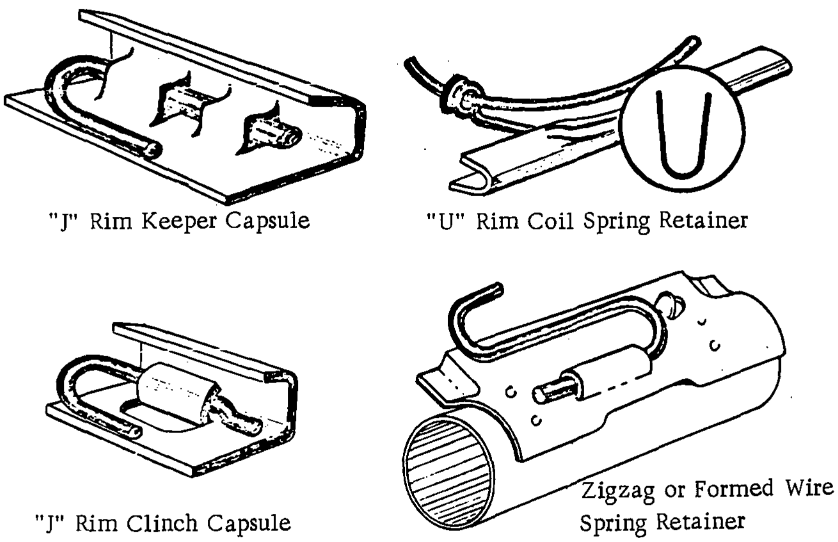
Stabilizer Brace

Attaching Clip

Slotted Clip

"C" Clip

Fig. 4-12 - Clips



"J" Rim Keeper Capsule

"U" Rim Coil Spring Retainer

"J" Rim Clinch Capsule

Zigzag or Formed Wire Spring Retainer

Fig. 4-13 - Spring retainers

Chapter 5
SEAT SPRING ASSEMBLY TEST METHODS

In order to determine the physical characteristics of a seat assembly, such as comfort, package, and durability life, unique measurement and test methods have been devised. Although the final evaluation is dependent on in-vehicle performance, preliminary evaluation is conducted on the seat assembly under a controlled laboratory standard. This is usually done on a comparative basis utilizing either a specific seat as a design image or with the evaluation standard based on accumulative data obtained from previous experience.

5.1 MEASUREMENT

5.1.1 FREE CONTOUR - The seat assembly is placed on a rigid fixture simulating vehicle position. A template with adjustable fingers is placed over the seat. The fingers are then adjusted to meet the seat surface and locked. The template is removed and placed on the full size package drawing whereby the contact points are plotted to indicate actual contour (Fig. 5-1).

5.1.2 PACKAGE CHECK - The seat assembly is placed on a rigid fixture simulating vehicle position. The SAE manikin is placed and adjusted on the seat in accordance with the SAE J826. The actual manikin position is obtained on a point-by-point basis with a rail mounted transit (horizontal) and bubble manometer (vertical) measurements made against a grid background. This procedure may also be performed with a seat installed in a vehicle (Fig. 5-2).

5.1.3 LOAD DEFLECTION - TRIMMED SPRING ASSEMBLY

5.1.3.1 Spring Assembly - The trimmed back or cushion spring assembly is installed in the deflection fixture. A vertical saddle load is applied in 30 increments to 190 lb for cushion spring assemblies and in 10 increments to 50 lb for back spring assemblies. Load versus vertical saddle penetration is plotted. This procedure may also be conducted on an untrimmed spring assembly by placing an insulator and slab pad over it (Fig. 5-3).

5.1.3.2 Individual Spring Element - An individual element may be evaluated by placing it in a rigid fixture that duplicates its attachment to the seat frame. Each element bar is loaded with a dead weight whereby the loaded position of the element is measured against a grid background (Fig. 5-4).

5.1.4 LOAD DISTRIBUTION - The trimmed back or cushion spring assembly is placed in the test fixture. A special saddle having seven individually suspended segments is lowered into the spring assembly where the force applied to each saddle segment by the spring assembly is measured. The vertical saddle force versus the individual segment load response is shown in bar graph form in Fig. 5-3.

5.2 TESTS

Dynamic tests are conducted to determine natural frequency, damping coefficient, rebound rate, and durability

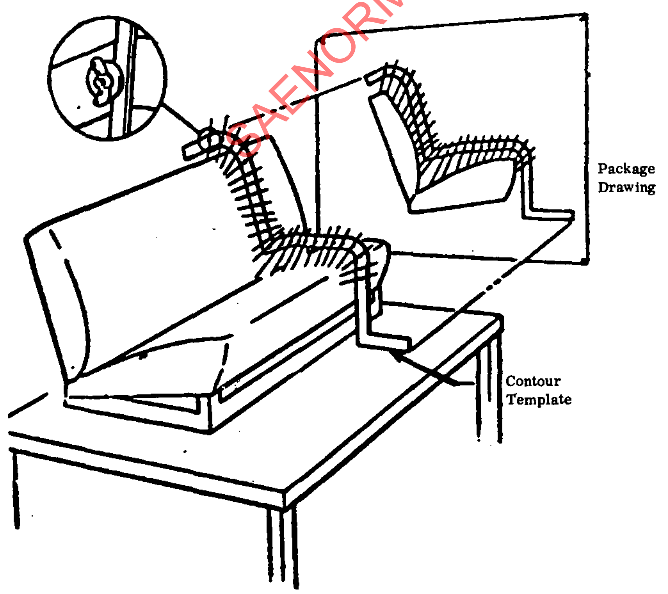


Fig. 5-1 - Free contour setup

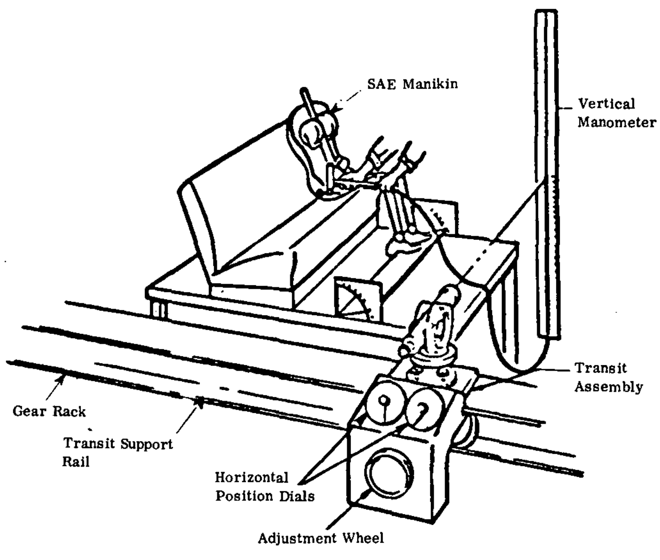


Fig. 5-2 - Package check setup

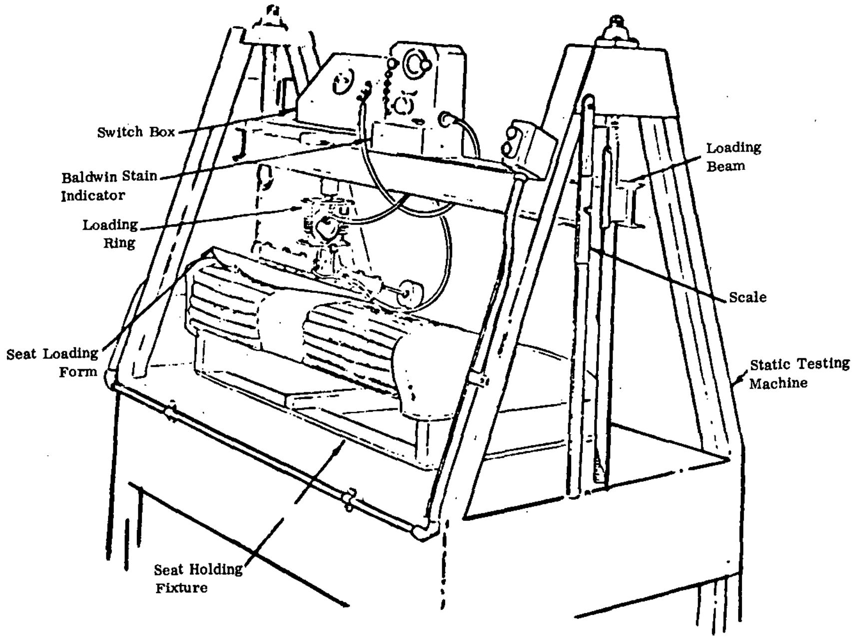


Fig. 5-3 - Load distribution test setup

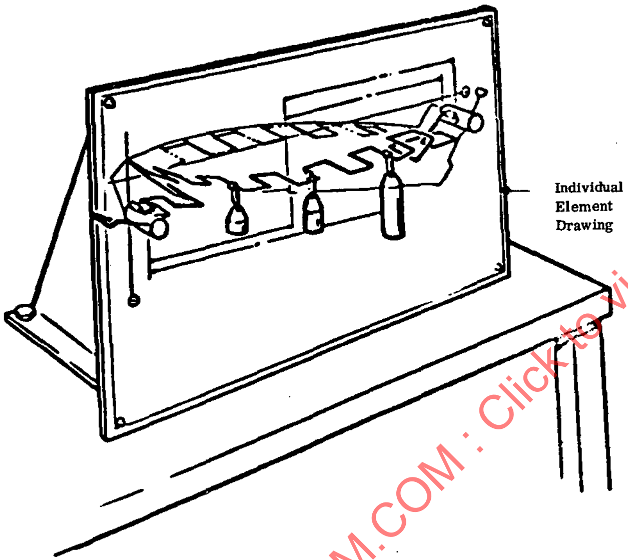


Fig. 5-4 - Single element load deflection setup

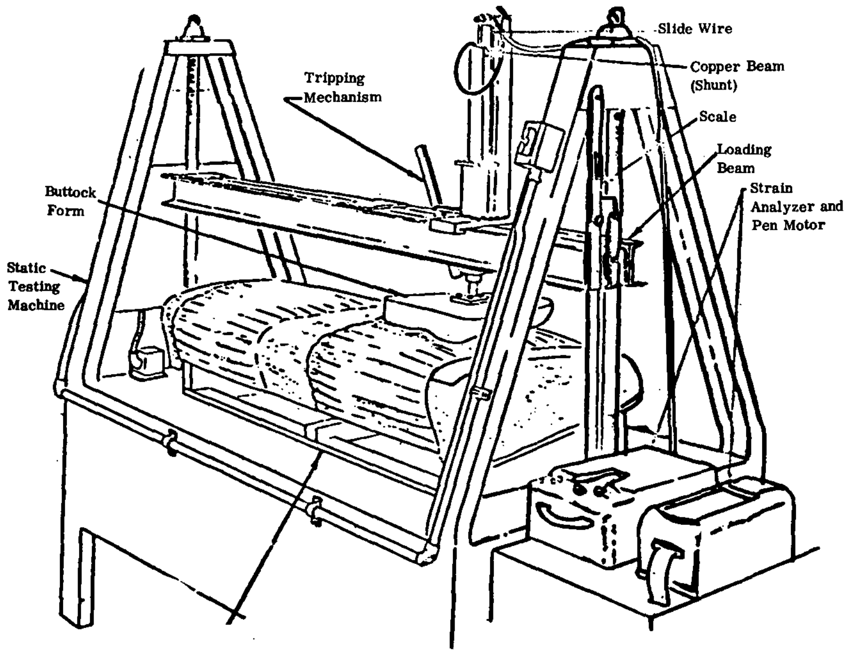


Fig. 5-5 - Seat drop test setup

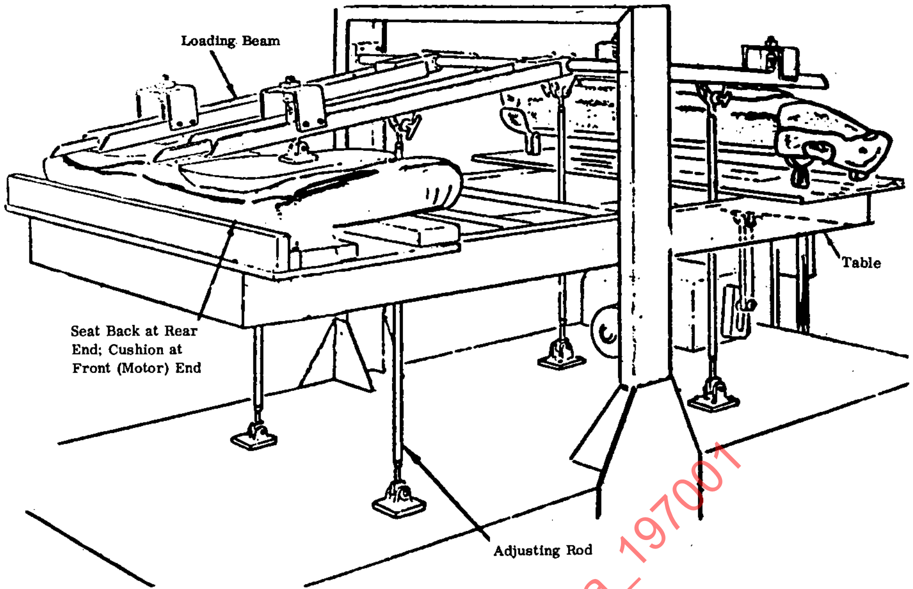


Fig. 5-6 - Seat fatigue test setup (constant deflection or constant work)

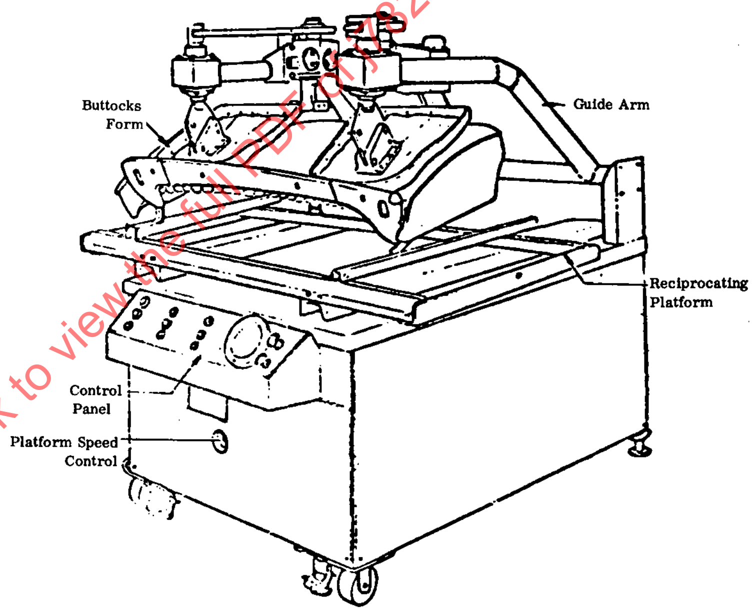


Fig. 5-7 - Seat fatigue test setup (constant work)

fatigue life. The following test methods are utilized for that purpose:

5.2.1 SADDLE DROP TEST (CUSHION) - The test saddle is lowered into the cushion until a load of 215 lb (conventional seats) or 250 lb (heavy-duty seats) has been reached. The saddle is raised 10 in. above the static load position and released. A suitable device attached to the saddle support shaft records the depth of penetration and dynamic characteristics (Fig. 5-5).

5.2.2 FATIGUE TEST - CONSTANT DISPLACEMENT - The test saddle (150 lb for cushions or 120 lb for backs) is placed on the spring assembly and lowered into it an additional 2 in. (conventional seats) to 3 in. (heavy-duty seats). The saddle support arm is held rigid whereby the platform-supported spring assembly (vertically reciprocating) is cycled 100,000 times or until failure occurs (Fig. 5-6).

5.2.3 FATIGUE TEST - CONSTANT WORK - The constant work method involves a cycling procedure with the spring assembly mounted on a vertically reciprocating platform with two guided test saddles riding on the seat. The cushion saddle is mounted on the cushion per vehicle package position, while the back is cycled in a horizontal position. The test displacement, which is held constant throughout test, is determined by the amount of penetration that results from a 280 lb static load for cushions and a 115 lb load for backs. The cycle life requirement ranges 50,000-65,000 cycles depending on seat usage (Fig. 5-7).

Chapter 6
PAD SUPPORTS

6.1 DEFINITION

A pad support in automotive seating is defined as a member placed on the top surface of a seat cushion or seat back spring assembly either independently or in combination with the padding member.

6.2 PURPOSE

The pad support is used to prevent the padding member from sagging between open spaces or voids in the spring assembly face, to distribute the load more evenly to the springs, and to increase life of the padding by preventing springs from penetrating same.

6.3 FUNCTIONS

A pad support should be sufficiently flexible so as not to alter the basic design characteristics of the seat cushion and seat back spring assemblies. For example, a supporting member of either sheet metal or plywood would be rigid and would, therefore, prevent cupping and sagging, but would also change the design characteristics of the spring assembly to a point where it would become virtually a rigid platform.

6.4 TYPES OF PAD SUPPORTS

6.4.1 WIRE TYPE - Usually made of 19 or 20 gage oil tempered wire, cut to desired length and laid parallel to each other with controlled spacing maintained by weaving through burlap, leno cloth, or other suitable fabrics.

The wires are usually placed fore and aft when used with coil spring assemblies and at right angles to the main spring elements when used with zigzag or formed wire spring assemblies. The types of pad supports shown may be attached to the spring assemblies or padding members.

Wire type supports are applied in one of five different methods:

6.4.1.1 Cut straight wires interlaced through burlap or suitable fabric and marginally clinched through several folded thicknesses of the fabrics.

6.4.1.2 Cut straight wires interlaced through burlap or suitable fabric, spaced from 1/2 to 2 in. apart in increments of 1/4 in. and marginally wrapped and clinched around paper cords (Fig. 6-1). The wire can be of constant or variable length to form end contours.

6.4.1.3 As above, except that the ends of each wire are looped to a 5/8 in. diameter loop. The burlap is from 1-1/2 to 2 in. wider on each side than the outside of the looped wires. The burlap is then folded over the loops and sewn down and the stitching, being to the inner side of the loops, thus holds the wires in position. This pad does not have the paper cord.

6.4.1.4 Cut wire formed into a long helical spring, interlaced through burlap and the cut ends of the wire looped (Fig. 6-2). The spiral shape of the wire permits it to be bent over the top side border wires of the spring assembly

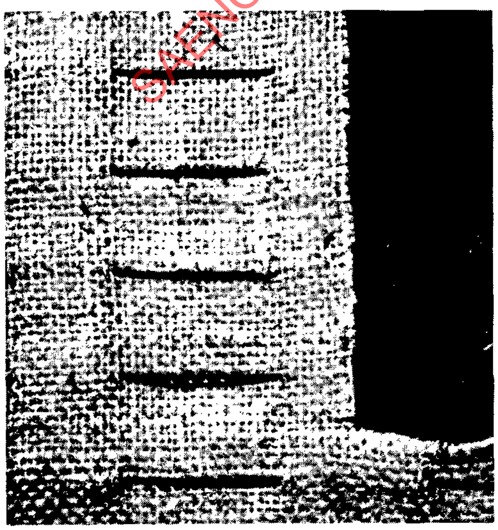


Fig. 6-1

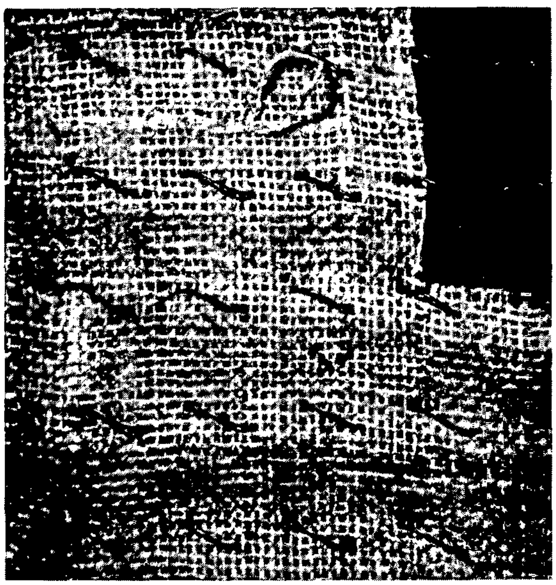


Fig. 6-2

Fig. 6-3

providing full top coverage of the spring assembly, if necessary. The gage of each wire may be varied, if necessary.

6.4.1.5 Monofilament Type - A continuous plastic lamination consisting of monofilament plastic extrusion or wire uniformly spaced between two sheets of polyethylene or other suitable film, the entire lamination being bonded by an adhesive.

This plastic type of pad support is generally used as a part of the padding member. It is often attached by sewing and extends the entire length of the padding member (Fig. 6-3).

6.4.2 OTHER TYPES - From time to time the industry has used various other means to accomplish a pad support, such as latexed hard loomed sisal or 10 oz burlap. The latexed hard loomed sisal is applied to the surface of the spring and attached by hog rings. The weight of the sisal is 4 oz/sq ft. The burlap is applied in the same manner as the sisal.

6.5 METHODS OF TEST

The life test as applied to the trimmed seat cushion or seat back assembly described in Chapter V is applied to the pad support. The functional life of the pad support itself should be equal to the life of the padding or spring assembly.

Chapter 7
PADDING

7.1 DEFINITION

The term "padding" in automotive seating usage refers to a body of soft and resilient material comprised of one or more components of cotton felt, rubberized curled hair, rubberized vegetable fiber, jute felt, sisal felt, burlap, latex foams, urethane foams, etc., permanently installed between the seat springs and seat trim covering. Padding is usually fabricated into a predetermined size, shape, and thickness, then draped or attached over a seat cushion or seat back spring assembly. In this built-up form, padding material or materials are known as a pad.

7.2 PURPOSE

The specific purpose of padding is to insulate the engaging portion of the seated occupant's body from the springs or back and to provide a cushioning member.

7.3 DESIGN REQUIREMENTS

From a design viewpoint the basic requirements of a good pad are as follows:

7.3.1 It should, even in long usage, not sag or cup between the elements of the spring assembly. The pad support (Chapter VI) is used with many pad designs to provide for this requirement.

7.3.2 It should yield to compression and possess a certain amount of elasticity in both length and width. This means the pad should yield and conform to the shape of the contacting portion of the occupant's body. Some elasticity is required to prevent fractures or tears in the padding material when the weight of the seated occupant depresses the cushion surface, increasing the length and, to a lesser degree, the width of the pad suspended over the spring assembly.

7.3.3 It should have a satisfactory rate of recovery of its free height.

7.3.4 It should show little or no permanent set after normal use.

7.3.5 It should possess a smooth top surface, in order to avoid a rough or lumpy seat cushion or back. Fibrous pads with improper or irregular distribution, lacking in carding character, may result in a lumpy appearance when the trim cover is applied over the padded spring assembly.

7.3.6 It should have uniformity, so that the designed contour of seat cushions and backs can be achieved in mass production. Varying thickness, density, and compression rate reflect comparable variations in the feel and service factors of the seat assembly.

7.3.7 It should have sufficient softness at light loads to provide "showroom feel."

7.4 FUNCTION

The primary function of the pad is to distribute the pressure between the cushion or back spring and the passenger's body. It also provides surface softness and affects damping of the cushion or back assembly.

7.5 PAD ELEMENTS

In current practices cushion padding is made up of one or more of the following elements:

7.5.1 FOUNDATION PAD - A bottom layer, made of more dense and usually less expensive materials, which acts as an insulator and filler over the spring assembly in conjunction with a pad support (Fig. 7-1).

7.5.2 INTERMEDIATE PAD - As the name implies, a layer of more resilient padding material designed to fit on top of the foundation pad (Fig. 7-2).

7.5.3 TOPPER PAD - The top layer of padding designed to fit immediately under the seat trim cover assembly (Fig. 7-3).

7.5.4 TRIM COVER FILLER PADS - Sometimes used to create design effects such as pipes, pillows, bolsters, etc. These filler pads are usually used as an integral part of the trim cover assembly.

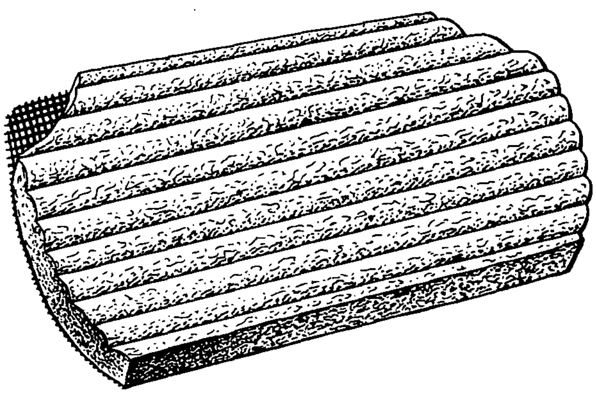


Fig. 7-1 - Foundation pad

7.6 PAD MATERIALS

7.6.1 FIBROUS MATERIALS

7.6.1.1 Foundation Pads

(a) Dark Cotton or Colored Cotton Felt - Generally a blend of cotton spinning mill by-products, fly or picker blended with cotton linters, cleaned, and garnetted.

(b) Sisal Felt - Fibrous portion of the sisal plant garnetted or carded and then interlaced or loomed into either loose or firm foundation pads.

(c) Interlaced Jute or Sisal - Garnetted jute or sisal fiber interlaced or needle-loomed with or without reinforcement into a dense firm felt.

The above felts may be sewn or otherwise attached to a reinforcement of burlap, sheeting, or tobacco cloth.

7.6.1.2 Intermediate Pads -

(a) Curled Hair - A blend of hog, cattle tail, or horse mane hair processed into a mat or pad.

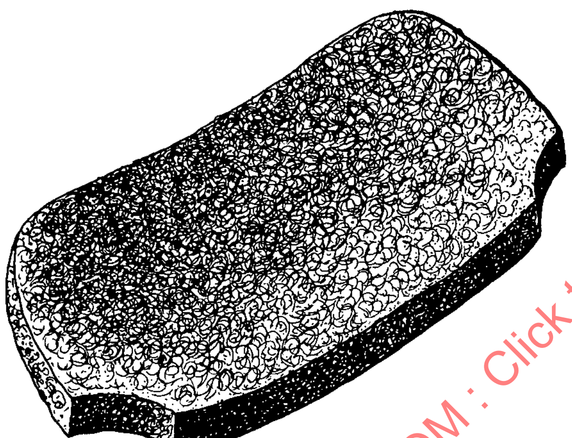


Fig. 7-2 - Intermediate pad

(b) Rubberized Curled Hair - Curled hair with rubber or neoprene latex sprayed through or vat dipped and cured to specified thickness and weight. Complete inpregnation of latex or neoprene is important.

(c) Rubberized Tula - Curled vegetable fiber (from tula plant) processed same as in (b).

(d) Rubberized Wool - Natural curl coarse wool processed as in (b).

(e) Synthetic - Plastic filaments steamed, curled, and processed as in (b).

7.6.1.3 Topper Pads - Cotton felt (usually white); a fine grade of cotton fabricated to a desired specification with or without tobacco cloth or other reinforcements.

7.6.1.4 Trim Cover Filler Pads -

(a) Fibrous Materials - Fibrous materials such as wool, acetates, linters, nylon, cotton, and/or blends of these materials formed into a pad. Shape retention is achieved by either sewing or thermal or electrical bonding the trim cover material to the pad.

(b) Cotton - Cotton either in a folded batt form or in a sheet form with a fabric backing for reinforcement.

7.6.1.5 Combination Pad - A combination of the foundation and topper pads into a unitized assembly (Fig. 7-4).

7.6.1.6 Combination Pad with attaching tape or listing sewn across top edge (Fig. 7-5).

7.6.1.7 Combination Pad with bolster and a higher density fibrous padding material sewn to cotton assembly. When this unit is assembled to the front back spring, the higher density material pads out the front back frame (Fig. 7-6).

7.6.1.8 Methods of Test - Fibrous materials such as cotton felt, sisal felt (both plain felted and needle interlaced), rubberized curled hair, and rubberized tula fiber pads are always specified in ounces or grams per square yard or square foot. Weight tolerances are usually given as ± 5% of the specified weight. Since thickness can generally be referenced to weight as applied to each particular type of fibrous pad, the weight tolerance affords the proper means of test.

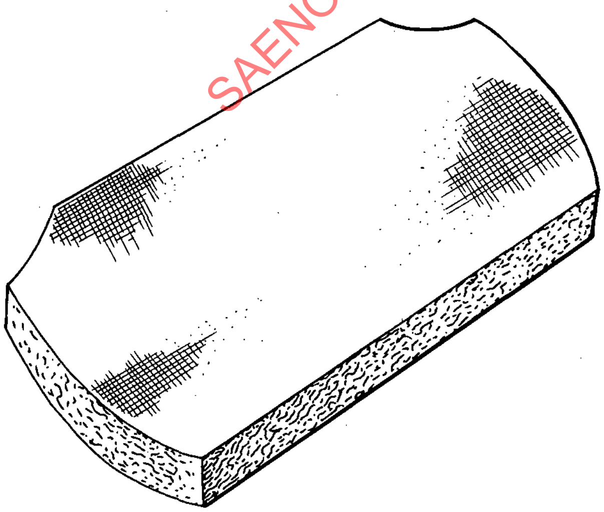


Fig. 7-3 - Topper pad

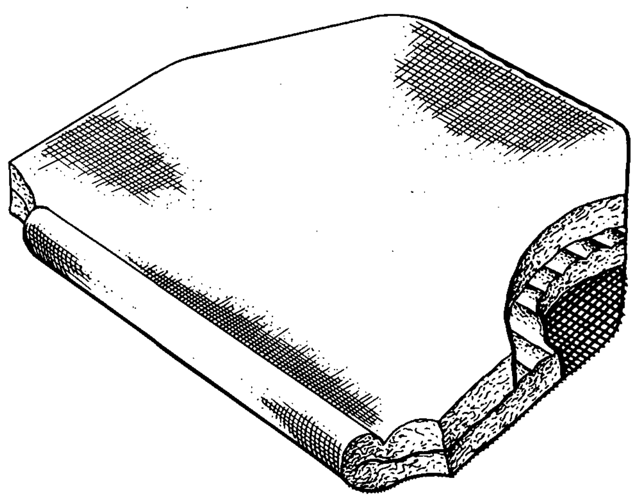


Fig. 7-4 - Combination pad

In the case of resin bonded fibrous materials, the weight per linear yard of nominal width indicates the thickness and density. The specification designation will vary with the different manufacturers of this type of material.

Folded cotton batts as used in pipe filling or edge reinforcement are always specified to desired width and ounces per linear yard. The ± 5% tolerance generally applies to both weight and width.

7.6.2 LATEX FOAM RUBBER - A cellular rubber product made from rubber latices or liquid rubber having a structure consisting of a network of open or interconnecting cells.

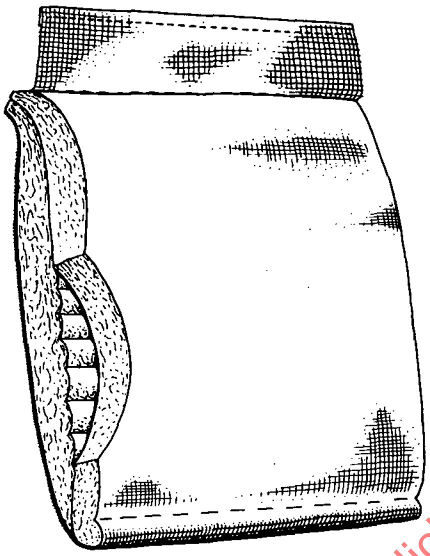


Fig. 7-5 - Combination pad with attaching tape

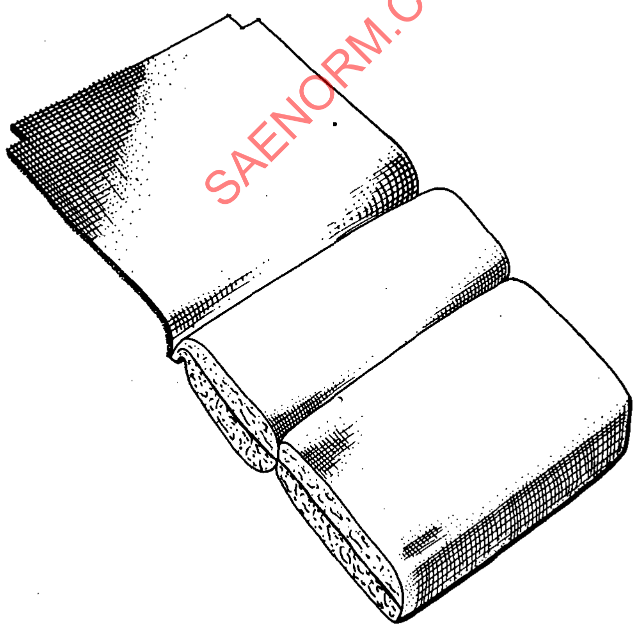


Fig. 7-6 - Combination pad with bolster

The term "rubber" as used above includes natural, synthetic, reclaim, rubber-like materials alone or in combination.

7.6.2.1 Nomenclature

(a) Cored Stock - Produce with molded cavities or core holes in a predetermined design or pattern (Fig. 7-7).

(b) Skin - Natural skin is defined as the smooth surface formed by contact with the mold (Fig. 7-7).

(c) Core Holes - The shaped cavity produced by the lugs, cores, or pins in the mold or top plate (Fig. 7-7).

(d) Dome - The rounded top of the core hole (Fig. 7-7).

(e) Top Slab - Thickness between the top of the dome and the top surface of the product (Fig. 7-7).

(f) Edge Wall - Width of uncored portion from edge to start of the cored portion (Fig. 7-7).

(g) Lip - Flange or projection along the side or edge of a cushion designed to extend below the bottom surface (Fig. 7-7).

(h) Attaching Tape - A tape, usually fabric cemented to the latex foam and used for attaching (Fig. 7-7).

(i) Edge Wall Measurement - Width of edge wall of straight row cores is measured from core wall edge to the core hole.

(j) Staggered Cores - Measured to the average of the core wall edge to core hole (Fig. 7-8).

(k) Uncored Stock - Material in sheet, strip, or slab can be cut to specified size.

7.6.2.2 Types -

(a) Intermediate Pad - As the name implies, a layer of latex foam of specified compression designed to fit between the foundation pad and the topper or trim cover filler pads. It can be cored or uncored (Fig. 7-9).

(b) Topper Pad - The top layer of latex foam of specified compression designed to fit immediately under the cover assembly (Fig. 7-10).

(c) Trim Cover Filler Pads - Sometimes used to create design effects such as pipes, pillows, bolsters, etc., either by sewing, dielectric bonding, or heat sealing to the trim cover assembly.

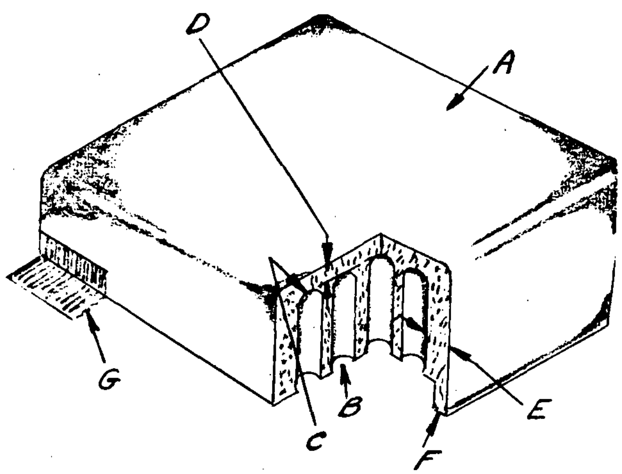


Fig. 7-7 - Cored stock

(d) Full Depth Pads - A pad of sufficient thickness and proper compression of latex foam to cushion the occupant properly. A full depth pad can be used with either a rigid or flexible base.

(e) Bolster Pad - Latex foam pad with bolster area molded in specific location (Fig. 7-11).

7.6.2.3 Specifications - The type of latex foam material and compressions are designated according to the SAE Standards for rubber products. (See latest issue of SAE J17 or ASTM D 1055.)

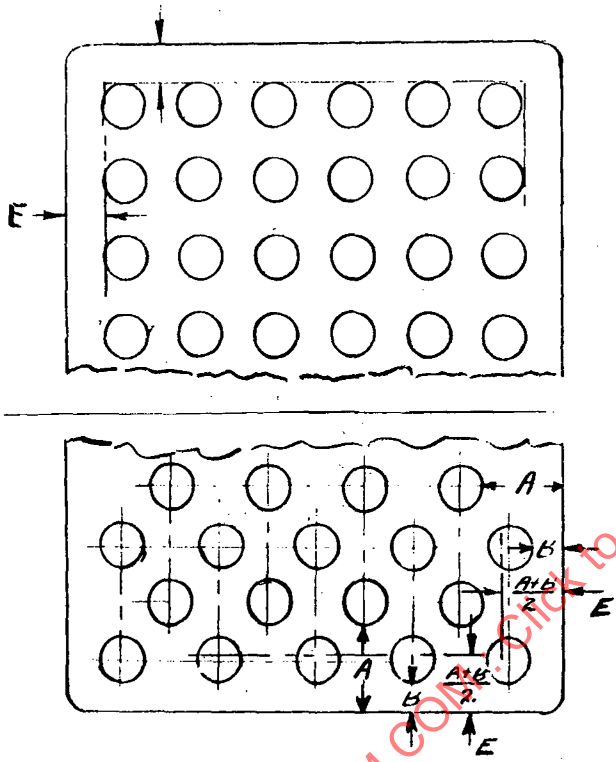


Fig. 7-8 - Staggered cores

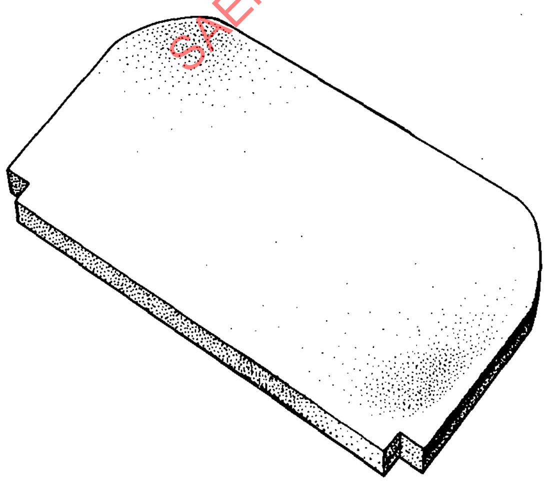


Fig. 7-9 - Intermediate pad

Cored latex foam is designated by RC and uncored latex foam by RU. Digits following the letters are used to indicate the degree of firmness. A typical designation for a cored latex pad would be RC-15. Here the RC indicates cored latex foam, and the 15 indicates a compression of 15 lb with a tolerance of ±4 lb or a range of 11-19 lb. This figure represents the loading required to depress 50 sq in. circular area 25% of its original thickness. Cored latex foam pads are manufactured in compression ranges from 5 to, and including, 90.

A typical designation for an uncored latex pad would be RU-20. Here the RU indicates uncored latex foam, and the 20 indicates the compression of 20 lb with a tolerance of ±5

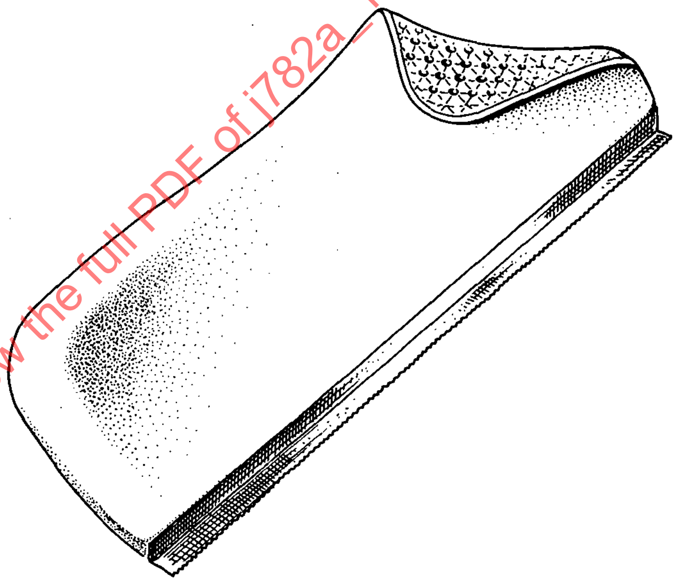


Fig. 7-10 - Topper pad

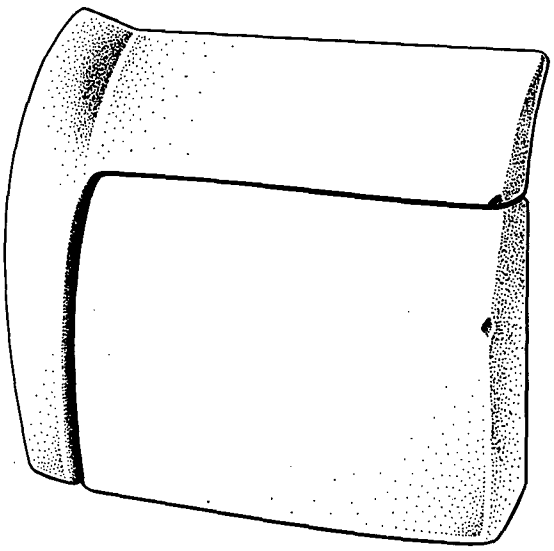


Fig. 7-11 - Bolster pad