NONMETALLIC GASKETS FOR GENERAL AUTOMOTIVE PURPOSES—SAE J90a

SAE Recommended Practice

Report of Nonmetallic Materials Committee approved January 1952 and last revised April 1963. This section of this SAE Recommended Practice on Method of Test for Compressibility and Recovery of Gasket Materials conforms with ASTM D 1147, Tentative Method of Test for Compressibility and Recovery of Gasket Materials. The remainder of this SAE Recommended Practice conforms with ASTM D 1170, Tentative Specifications for Nonmetallic Gasket Materials for General Automotive and Aeronautical Purposes.

[This SAE Recommended Practice was formulated by the SAE—ASTM Technical Committee on Automotive Rubber.]

Scope—These specifications for SAE J90 are intended to define the basic properties of commercial nonmetallic gasketing materials commonly used in automotive applications. These include materials composed of asbestos or other inorganic fibers, cork, or cellulose or other organic fibers, in combination with various binders or impregnants. Rubber compounds without fibrous or cork reinforcement are not included since they are covered in SAE Standard, Specifications for Elastomer Compounds for Automotive Applications—SAE J14, and in ASTM D 735-61T. Although the test methods and values are designed to describe the basic properties of the material in each category, they do not define all of the properties which govern gasket performance. Caution should, therefore, be exercised in using these specifications as a basis for the selection of materials.

Numbering System

Types—The various categories of material are grouped into three types, according to whether the principal fibrous or particulate reinforcement is asbestos or other inorganic fibers (Type 1), cork (Type 2), or cellulose or other organic fibers (Type 3).

Identification—Each category is identified by a number consisting of four digits and a suffix letter. The significance of these is shown in Table for System of Identification.

Coated Gaskets—Gaskets from materials conforming to these specifications may be coated on one or more sides. Because of the many possible coating materials and thicknesses, it is suggested that coating specifications be given on the blueprints.

Detailed Requirements—Gasket materials shall conform to the requirements as prescribed in the tables as follows:

Type 1—Table 1
Type 2—Table 2
Type 3—Table 3

Methods of Test

Sampling—Specimens shall be selected from finished gaskets or sheets of suitable size, whichever is the most practicable. If sheets are used, they shall, where applicable, be cut squarely with the grain of the stock and the grain direction noted by an arrow.

For qualification purposes, thicknesses shall be used as follows:

Type 1—1/32 in.
Type 2—1/16 to 1/4 in.
Type 3—1/32 in.

When thicknesses other than those shown above are to be tested, the specification limits shall be agreed to, in writing, between purchaser and supplier.

Sufficient specimens shall be selected to provide a minimum of three determinations for each test described in subsequent paragraphs. The average of the determinations shall be considered as the result.

Conditioning—Prior to all tests, specimens shall be conditioned as follows:

Type 1—Specimens shall be conditioned in an oven at 212 ±2 F for 1 hr and allowed to cool to 70-85 F in a desiccator containing anhydrous

TABLE FOR SYSTEM OF IDENTIFICATION

	Type 1	Type 2	Type 3
First digit (principal fibrous or particulate material)	1. Asbestos or other inorganic fibers	2. Cork	3. Cellulose or other organic fibers
Second digit (trade designation)	1. Compressed asbestos sheet 2. Asbestos beater sheet 3. Asbestos paper and millboard	1. Cork composition 2. Cork and rubber 3. Cork and cellular rubber	0. Tag 1. Chipboard 2. Vulcanized fiber 3. Cellulose fiber 4. Fiber and filler compositions
Third digit (binder or treatment other than sizing)	(Same for all three types) 0. None 1. Protein (glue-glycerine or equivalent) 2. Resin 3. Rubber, Type S, Class SA (polysulfide or equivalent) 4. Rubber, Type S, Class SB (acrylonitrile or equivalent) 5. Rubber, Type S, Class SC (chloroprene or equivalent) 6. Rubber, Type R (natural, reclaim, styrene or equivalent)		
Fourth digit (Compressibility Index ASTM D 1147-61T Procedure G, total load—1000 psi)	(Same for all three types) 0. 0–5% 1. 6–15% 2. 16–25% 3. 26–35% 4. 36–45% 5. 46–55% 6. 56–65% 7. 66–75% 8. 76–85% 9. 86–95% For identification purposes only. May not agree with compressibility in tables where other loads are employed.		
Suffix letter	Used to distinguish grades of material within one four digit category which differ sufficiently to justify separate tabular values. If only one grade of material is listed in the table, the letter "A" is used.		

EXAMPLE:

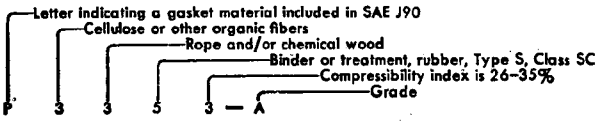

TABLE 1—TYPE 1—ASBESTOS OR OTHER INORGANIC FIBERS

Identification No.[a]	Former "G" No. (For Reference Only)	Original Properties: Compressibility: Total Load, psi	Compressibility, %	Recovery, min, %	Tensile Strength, min, psi	Ignition Loss, max, %	Properties after Immersion in Liquids: After Aging 5 Hrs at 300 F in ASTM Oil No. 3: Compressibility, max, %	Loss in Tensile Strength, max, %	Thickness Increase, %	After Aging 5 Hrs at 70–85 F in ASTM Reference Fuel B: Weight Increase, max, %	Thickness Increase, %
P1141A	G1122–1	5000	7–17	40	2000	—	20	30	0–13	20	0–15
P1151A	G1123–1	5000	7–17	40	2000	—	30	50	15–30	30	10–25
P1161A	G1111–1	5000	7–17	40	2000	—	—	70	20–50	40	15–35
P1161B		5000	7–17	40	2000	—	—	80	40–70	50	25–45
P1162A	G1111–2	5000	15–25	30	1600	—	—	70	20–50	40	15–35
P1241C	—	5000	13–23	35	1000	—	30	35	5–20	30	0–15
P1242C	—	5000	30–40	30	1700	—	45	15	0–20	50	0–15
P1242D	—	5000	20–30	35	2000	—	35	20	0–20	40	0–15
P1243A	G1422–2	5000	35–50	15	500	—	55	25	0–5	50	0–5
P1251A	G1423–1	5000	10–20	40	2000	—	35	40	10–20	35	0–15
P1252A	G1423–2	5000	20–30	35	1000	—	—	60	20–35	50	5–20
P1252D	—	5000	30–40	35	1200	—	45	30	10–25	50	5–20
P1252E	—	5000	20–30	35	1200	—	40	40	10–25	45	5–20
P1253A	G1423–3	5000	35–50	20	1000	—	—	50	0–15	55	0–10
P1261A	—	5000	15–30	30	1200	—	—	60	10–25	60	5–20
P1262B	—	5000	25–40	35	1000	—	—	80	10–40	70	0–30
P1301A[b]	G4131	1000	6–15	40	200	20	—	—	—	—	—
P1302A	G4111	1000	16–25	30	175	20	—	—	—	—	—

[a] These thickness tolerances are permissible variations applicable to given lot of sheets of gaskets. Where special thickness tolerances are necessary due to application, the tolerance on individual sheet or gasket shall be agreed to in writing, between the supplier and customer.

Series	Thickness, in.	Tolerance, in.	Series	Thickness, in.	Tolerance, in.
P1100 and P1200	1/64 and under	+0.005 −0.002	P1301A P1302A	—	±10%
	Over 1/64 and under 1/16	±0.005		Up to 1/8	±0.005
	1/16 and over	±0.008		1/8 to 1/2	±0.010

TABLE 2—TYPE 2—CORK

Identification No.[a, b]	Former "G" No. (For Reference Only)	Original Properties: Compressibility: Total Load, psi	Compressibility, %	Recovery, min, %	Tensile Strength, min, psi	Density min, lb per cu. ft	Flotation Tests: 3 Hr in Boiling Water	1/2 Hr in Boiling 35% HCl	2 Hr at 212 F in ASTM Oil No. 1	Flexibility Factor, F	Properties after Immersion or Aging: After Oven Aging 70 Hr at 212 F: Flexibility Factor, F	After Aging 70 Hr at 212 F in ASTM Oil No. 1: Flexibility Factor, F	Volume Change, %	After Aging 70 Hr at 212 F in ASTM Oil No. 3: Volume Change, %	After Aging 22 Hr at 70–85 F in ASTM Reference Fuel A: Volume Change, %
Cork Composition															
P2116A	G2114	100	10–25	60	175	24	N	—	N	5	—	—	—	—	—
P2117A	G2113	100	15–30	65	150	20	N	—	N	5	—	—	—	—	—
P2117B	G2112	100	20–40	75	100	17	N	—	N	5	—	—	—	—	—
P2118A	G2111	100	30–50	80	75	14	N	—	N	5	—	—	—	—	—
P2126A	G2214	100	10–25	60	175	24	N	N	N	5	—	—	—	—	—
P2127A	G2213	100	15–30	65	150	20	N	N	N	5	—	—	—	—	—
P2127B	G2212	100	20–40	75	100	17	N	N	N	5	—	—	—	—	—
P2128A	G2211	100	30–50	80	75	14	N	N	N	5	—	—	—	—	—
Cork and Rubber															
P2236A	G1221–3	400	25–45	75	200	—	—	—	—	5	16	16	−5 to +5	0 to +10	−5 to +5
P2243A	G1222–2	400	15–25	75	250	—	—	—	—	5	16	16	−5 to +10	−2 to +15	−2 to +10
P2245A	G1222–3	400	25–35	75	250	—	—	—	—	5	16	16	−5 to +10	−2 to +15	−2 to +10
P2245B	—	400	40–55	70	150	—	—	—	—	5	16	16	−15 to +15	0 to +25	−5 to +15
P2246A	G1222–4	400	35–45	75	200	—	—	—	—	5	16	16	−5 to +10	−2 to +15	−2 to +10
P2254A	G1223–2	400	15–25	75	250	—	—	—	—	5	16	16	−2 to +20	+15 to +50	0 to +15
P2255A	G1223–3	400	25–35	75	250	—	—	—	—	5	16	16	−2 to +20	+15 to +50	0 to +15
P2255B	—	400	40–55	75	125	—	—	—	—	5	16	16	−10 to +5	+15 to +50	0 to +35
P2256A	G1223–4	400	35–45	75	220	—	—	—	—	5	16	16	−2 to +20	+15 to +50	0 to +15
P2265A	G1211–3	400	25–45	75	150	—	—	—	—	5	16	—	—	—	—
P2268A	G1211–5	400	40–60	75	75	—	—	—	—	5	16	—	—	—	—
Cork and Cellular Rubber															
P2347A	—	100	35–50	75	100	—	—	—	—	5	16	—	−20 to −5	−10 to +5	−10 to +5
P2357A	—	100	35–50	75	75	—	—	—	—	5	16	—	−10 to +10	15 to 50	0 to 25
P2367A	—	100	35–50	75	100	—	—	—	—	5	16	—	—	—	—

N = No disintegration

[a] Thickness Tolerances:
P2100 Series—±10% or ±0.010 in. whichever is the greater.
P2200 Series—Under 1/16 in. ±0.010 in., 1/16 in. and over, ±0.015 in.
P2300 Series—1/16 in. (minimum thickness) and over ±0.015 in.

[b] Grain size may be specified for certain applications. If so, the following definitions will usually apply:
Fine—Pass a No. 20 sieve and retained on a No. 40 sieve.
Medium—Pass a No. 10 sieve and retained on a No. 20 sieve.
Coarse—Pass a No. 5 sieve and retained on a No. 10 sieve.
[Sieve sizes are as specified in ASTM E 11—39, Specification for Sieves for Testing Purposes (Wire Cloth Sieves, Round-Hole and Square-Hole Screens, or Sieves), Table 1.]

calcium chloride, except that P1300 series shall be conditioned in an oven for 4 hr at 212 ±2 F.

Type 2—Specimens shall be conditioned at least 46 hr in a controlled humidity room or in a closed chamber with gentle mechanical circulation of the air at 70-85 F and 50-55% relative humidity.

Type 3—Specimens shall be preconditioned for 4 hr at 70-85 F in a closed chamber containing anhydrous calcium chloride as a desiccant. The air in the chamber shall be circulated by gentle mechanical agitation. Specimens shall then be transferred immediately to a controlled humidity room or closed chamber with gentle mechanical circulation of the air and conditioned for at least 20 hr at 70-85 F and 50-55% relative humidity.

If a mechanical means of maintaining 50-55% relative humidity is not available, a tray containing a saturated solution of reagent grade magnesium nitrate $Mg(NO_3)_2\ 6H_2O$ shall be placed in the chamber to provide the required relative humidity. In all cases where testing is conducted outside the area of specified humidity, specimens shall be removed from the chamber one at a time as needed.

Compressibility and Recovery—Specimens shall be tested according to procedures outlined in ASTM D 1147-61T, Method of Test for Compressibility and Recovery of Gasket Materials, as follows:

Type 1—P1100 and P1200 series—Procedure A
P1300 series —Procedure H
Type 2—P2100 and P2300 series—Procedure F
P2200 series —Procedure B
Type 3 —Procedure G

Thickness—Specimens shall be measured with a dial type micrometer actuated by a dead weight load. The dial shall be graduated in 0.001 in. or smaller units and readings shall be estimated to the nearest 0.0001 in. The anvil shall have a diameter not less than that of the presser foot.

Loads and presser foot diameters shall be as follows:

Type	Total Load on Presser Foot, oz. (Reference)	Load on Sample, psi	Presser Foot Dia, in.
1	9.0	11.5±1.0	0.252±0.005
2	4.0	5.1±1.0	0.252±0.005
3	6.3	8.0±1.0	0.252±0.005

Readings shall be taken by lowering the presser foot gently until it is in contact with the specimen. A sufficient number of readings shall be taken, depending on the size of the specimen, to provide a reliable average value.

Tensile Strength—An acceptable tension testing machine, spring actuated type, pendulum type, or equivalent shall be used. The power actuated jaw shall be driven at the rate of 12 ± 1 in. per minute. It shall be equipped with a load indicator which will indicate the point of maximum load after rupture of the specimen. The normally used range of the machine should be 15-85% of the full range of the load indicator scale in use.

Specimens shall be prepared and placed in the testing machine as follows, after being measured for thickness according to paragraph on Thickness:

Type 1—Paragraph 6(c), ASTM D 733-59, Methods of Testing Compressed Asbestos Sheet Packing, except that only the direction perpendicular to the grain shall be tested.

Type 2—Specimens shall be 2 in. in width. They shall be placed in the machine with a 2 in. distance between the jaws and shall be gripped for at least 1 in. in each jaw.

Type 3—Specimens shall be 1 in. in width by 6 in. long. The lengthwise direction of the specimen shall be perpendicular to the grain direction of the material. They shall be placed in the machine with a 4 in. distance between the jaws. Specimens of ½ in. in width may be used where necessary to fall within the range of the load indicator.

In all cases, specimens shall have cleanly cut edges and shall be carefully aligned with the direction of travel of the jaws.

Tensile strength shall be calculated by dividing the breaking load in pounds by the original cross sectional area of the specimen in square inches and shall be expressed in pounds per square inch.

Immersion in Liquids

Type 1—Apparatus used shall be as specified in Paragraph 6, ASTM D 471-62T, Method of Test for Change in Properties of Elastomeric Vulcanizates Resulting from Immersion in Liquids. Fresh test fluid shall be used for each determination. Specimens immersed in fuel shall be tested within 30 sec after removal from the test medium. Specimens immersed in hot oil shall be removed and immediately immersed in a cool, clean portion of the test medium for 30 to 60 minutes, then dipped quickly in acetone and blotted lightly with filter paper.

Tensile strength shall be determined according to paragraph on Tensile Strength and shall be based on the cross sectional area before immersion.

Compressibility shall be determined according to paragraph on Compressibility and Recovery and shall be based on the thickness after immersion.

Thickness and weight change specimens shall be 1 x 2 in. in size. Thickness before and after immersion shall be measured according to paragraph on Thickness and determined in the same areas of the specimen. The change shall be calculated as a percentage of the original thickness. Weight measurements before and after immersion shall be made to the nearest milligram in a sealed, tared container and the change calculated as a percentage of the original weight.

Type 2—Specimens for volume change shall be tested in accordance with ASTM D 471-62T, Method of Test for Change in Properties of Elastomeric Vulcanizates Resulting from Immersion in Liquids.

For materials having a specific gravity of less than 1.00, the following procedure shall be used if a Jolly Balance is employed:

(a) The Jolly Balance, properly shielded from drafts, is leveled and zeroed.
(b) A small metal sinker (5 g is usually sufficient) is attached to the weighing hook so that it is totally immersed in water.
(c) The specimen is then weighed in air and the scale reading SR_1 is recorded.
(d) The specimen is then weighed in water and the scale reading SR_2 is recorded.
(e) V_1 then equal $(SR_1 - SR_2)$.
(f) After removing the specimen from the test medium, steps c, d, and e are repeated. (Caution: Use same sinker throughout.) This gives V_2. The distilled water used in the test must be changed frequently.

$$\frac{V_2 - V_1}{V_1} \times 100 = \% V$$

where: V_1 is original volume.
V_2 is volume after removal from liquid.
%V is per cent volume change.

Specimens for flexibility shall be immersed according to ASTM D 471-62T, Method of Test for Change in Properties of Elastomeric Vulcanizates Resulting from Immersion in Liquids. The specimens shall be prepared and tested according to paragraph on Flexibility (Type 2 only).

Type 3—Specimens shall be cut with a minimum width of 1 in. or a minimum diameter of 1.129 in. and ranging from 1 to 4 sq in. in area prior to conditioning. After conditioning, a specimen shall be transferred as rapidly as possible to a tared weighing bottle of suitable dimensions and weighed to the nearest milligram. The specimen shall then be removed and measured for thickness according to paragraph on Thickness. The specimen shall then be immersed in the test medium for the specified length of time. A container of convenient size shall be used so as to provide a minimum of 10 ml of test fluid per sample. Light wire screens may be used, if necessary, to keep specimens immersed or separated from each other.

Upon removal, the specimen shall be blotted as rapidly as possible with sheets of Whatman No. 1 filter paper, or paper of similar texture, to remove excess liquid from the surface. Care must be exercised to remove all of the surface excess but not to exert any squeezing action upon the specimen. Specimens over 1/32 in. in thickness shall also be blotted on the edges.

The specimen shall then be placed immediately in the tared weighing bottle and reweighed to the nearest milligram. The change in weight shall be calculated as a percentage of the initial weight of the specimen. The specimen shall then be removed from the weighing bottle and measured for thickness in the same areas as the initial set of measurements according to the paragraph on Thickness. Both sets of measurements shall be averaged to the nearest 0.0001 in. and the change calculated as a percentage of the initial thickness.

Loss on Ignition (Type 1 Only)—A specimen weighing from 5 to 10 g shall be disintegrated, conditioned as in paragraph on Conditioning, cooled in a desiccator and weighed. It shall be ignited in a crucible at 1500 F for not less than 1 hr, cooled in a desiccator and reweighed. The loss on ignition shall be calculated as a percentage of the original weight.

Oven Aging (Type 2 Only)—Specimens shall be aged in accordance with ASTM D 573-53, Standard Method of Test for Accelerated Aging of Vulcanized Rubber by the Oven Method.

Flexibility shall be determined in accordance with paragraph on Flexibility (Type 2 only) after conditioning the oven aged specimens for 24 ±1 hr at 70-85 F at 50-55% relative humidity.

Flexibility (Type 2 Only)—Specimens shall be 1/2 in. wide, 6 in. long, and 3/16 in. maximum thickness. The material shall not crack, break, or separate when bent slowly 180 deg around a mandrel of appropriate diameter. The diameter of the mandrel is determined by multiplying the thickness of the material by its flexibility factor "F."

Density (Type 2 Only)—Specimens shall have an area of at least 2 sq in. Thickness shall be measured according to paragraph on Thickness. Length and width shall be measured to an accuracy of 0.01 in. Weight shall be determined to an accuracy of ±1%. Density shall be calculated by dividing the weight of the specimen by its volume and shall be expressed in pounds per cubic foot.

Flotation (Type 2 Only)—Specimens of not less than 1 sq in. in area shall be floated in liquids under the conditions specified and shall be examined for evidence of disintegration upon conclusion of the test.

(Table 3 appears on next page)