SAE Aerospace
An SAE International Group

AEROSPACE STANDARD

SAE AS50141

REV. A

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Superseding AS50141

(R) Tube, Pneumatic Tire, Aircraft

1. SCOPE:

This SAE Aerospace Standard (AS) establishes requirements for manufacturing, testing, identification, packaging, and quality of tubes for application in commercial and military aircraft wheel assemblies.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 Tire and Rim Association (TRA) Publication: Available from The Tire and Rim Association, Inc., 175 Montrose West Avenue, Suite 150, Copley, OH 44321; Website: http://www.us-tra.org; Phone: 330-666-8121.

Aircraft Yearbook

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: 724-776-4970 (outside USA)
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Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

2.1.2 American Society for Testing and Materials (ASTM) Publications: Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959; Website: http://www.astm.org

ASTM D 412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 746	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D 5118	Standard Practice for Fabrication of Fiberboard Shipping Boxes

2.1.3 American Society for Quality Control Publication: Available from American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203; Website: http://www.asq.org; Phone: 1-800-248-1946 / 414-272-8575.

ANSI/ASQC Z1.4	Sampling Procedures and Tables for Inspection by Attributes

2.1.4 U.S. Government Publications:

TSO-C62	Tires

(Available from http://www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgtso.nsf/MainFrame?OpenFrameSet)

MIL-PRF-5041	Performance Specification, Tires, Ribbed Tread, Pneumatic, Aircraft, General Specification For

(Available from Document Automation and Production Service, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094; Website: http://assist.daps.dla.mil/quicksearch/; Phone: 215-697-6257)

2.2 Definitions:

2.2.1 LOT: Unless otherwise specified, a lot shall include all tubes of the same size manufactured during one continuous production run.

2.2.2 TUBE: A tube is defined as the internal component of a pneumatic tire used primarily as an air-retaining chamber. A conventional pneumatic tire consists of an assembly of the casing and tube.

2.2.3 FABRIC BASE: To prevent wheel chafing, some tubes are manufactured with a fabric base. The fabric reinforces the inside diameter (base) of the tube.

3. REQUIREMENTS:

3.1 Qualification:

The tubes furnished under this specification shall be products that are authorized by the procuring activity. Changes in plants, construction, materials or processes that affect performance of the tube shall require requalification per this specification. Qualification testing of a specific tube size need not be re-accomplished if the contractor has been granted qualification approval and the materials and processes for that tube size have not changed.

3.2 Materials:

The materials shall meet the performance requirements specified both herein and by the pertinent reference documents.

3.2.1 Physical Properties of Tube Material: The physical properties of the material used in the tube body shall comply with Table 1, if all natural rubber, or Table 2, if butyl/EPDM rubber, requirements.

TABLE 1 - Tube Physical Properties Using All Natural Rubber

Property	Before Aging	After Aging
Minimum Tensile Strength (psi)	2,100	--
Minimum Elongation (percent)	550	--
Maximum Set Stretch (percent)	--	18
Tensile Strength of Splice[1]	--	--
Minimum (psi)	1,200	--

[1]Based on cross-sectional area of the rubber adjacent to the splice.

TABLE 2 - Tube Physical Properties Using Butyl/EPDM Blends

Property	Before Aging	After Aging
Minimum Tensile Strength (psi)	1,000	--
Minimum Elongation (percent)	350	--
Maximum Set Stretch (percent)	--	22
Tensile Strength of Splice1	--	--
Minimum (psi)	500	--

[1]Based on cross-sectional area of the rubber adjacent to the splice.

3.2.2 Operating Temperature Range: The selected materials shall maintain their intended properties within a temperature range of -50 to 52 °C (-58 to 125 °F). The tube and valve core materials shall satisfactorily pass the low temperature test specified in 4.5.7.

3.3 Physical Characteristics:

Tube gauge, weight, static unbalance, and valve configuration/components shall comply with Table 3 requirements. All military tubes shall be provided with TR VC-5 caps.

3.3.1 Vent Ridges: Vent ridges shall be provided to prevent air entrapment between the tire casing and tube. It is recommended that the ridge groups be spaced at approximately 6-inch intervals, and be molded 0.015 inch deep and 0.030 inch wide.

3.3.2 Balance: Each fabric base tube, with the valve installed, shall be checked for balance and shall conform to the requirement specified in Table 3. Hot or cold patches, if used, shall have beveled or step-off edges, shall be neatly applied, and shall be clearly marked to indicate that they are balance patches. All-rubber tubes do not require an individual balance check (except as noted in Section 4), but shall be manufactured such that the balance requirements specified in Table 3 are met.

3.3.3 Thickness: Recommended gauge thickness values for tubes are given in Table 3 [Table 3, Column 2, is given for Reference only - linked to the use of natural rubber]. Tubes made from alternate materials may be thinner in gauge provided the performance characteristics of 3.2.1, Table 2, and 4.5 can be achieved.

3.4 Valve Attachment Strength:

Fabric base tubes with a TR-60, TR-67, TR-168, or TR-176A valve shall meet the applicable valve attachment strength requirement as specified in Table 4.

TABLE 3 - Physical Characteristics

Size	Recommended Thickness (inches) (Reference Only)		Minimum Reinforcement Half Width (inches) (1)(2)	Maximum Weight (pounds)	Maximum Static Unbalance (inch-ounces)	*Valve TR No.
	Crown	Base				
8.00	.060	--------	----------	0.53	(3)	12
10.00	.060	--------	----------	0.80	(3)	12
14.50	.060	--------	----------	1.6	(3)	20
27	.060	.080	----------	5.3	6	25
33	.070	.100	----------	9.0	11	14M, 94-B
36	.070	.100	----------	11.2	16	227-A
44	.080	.115	----------	17.2	25	99-C, 176A
44 (2)(11)	.095	.110	7.25	18.1	25	227-A
47	.080	.115	----------	23.4	28	227-A
56 (2)(11)	.120	.160	8.50	39.3	40	93-E
5.00-4	.070	.075	----------	1.35	4	AC21, 60, 67-A
5.00-5	.060	.060	----------	1.4	4	67-A, 88
6.00-6	.060	.060	----------	2.12	4	20, 67
6.50-8	.060	.060	----------	3.0	6	15
6.50-10	.060	.090	----------	4.24	8	25
7.00-6	.060	.060	----------	3.25	5	20
7.00-8	.060	.085	----------	3.25	7	15, 67
7.50-10	.060	.100	----------	4.8	8	14M, 25 (7), 193
7.50-14	.070	.100	----------	5.0	8	176A-E
8.00-4	.090	.090	----------	2.1	4	12
8.00-6	.060	.060	----------	3.25	5	20
8.50-6	.060	.060	----------	4.0	8	20
8.50-10	.060	.100	----------	5.1	8	25
8.90-12.50	.080	.090	----------	8.0	12	15
9.00-6 (4)	.060	.060	----------	4.0	8	69-Straight
9.00-6 (5)	--------	--------	----------	4.0	8	69-A
9.50-16	.070	.100	----------	8.5	10	176A-E
10.00-7	--------	--------	----------	6.35	9	350
11.00-12 (4)	.090	.090	----------	8.0	12	13
11.00-12 (5)	.090	.090	----------	8.0	12	150CW
12.50-16	.070	.110	----------	14.0	18	101-C
15.00-16	.090	.140	----------	18.6	22	92-A
15.50-20	.090	.140	----------	21.2	26	92-C
17.00-16	.090	.140	----------	21.2	26	91-G
17.00-20 (2)(11)	.100	.150	5.50	27.6	40	92-C
19.00-23 (2)(11)	.100	.150	7.75	36.0	41	98-B
20.00-20	.100	.110	----------	34.0	45 (6)	193-Bent
20.00-20 (2)(11)	.100	.150	6.25	34.0	45 (6)	193-Bent
25.00-28 (2)(11)	.150	.180	8.75	76.0	200	193-Bent
12.50x4.5	.120	.120	----------	1.8	(3)	89-Bent
16x4.4	.085	.085	----------	2.8	4	60, 60-B
16x4.4 (2)(11)	.090	.150	1.25	2.8	4	60-B

TABLE 3 - Physical Characteristics (Continued)

Size	Recommended Thickness (inches) (Reference Only) Crown	Base	Minimum Reinforcement Half Width (inches) (1)(2)	Maximum Weight (pounds)	Maximum Static Unbalance (inch-ounces)	*Valve TR No.
18x4.4	.090	.100	----------	3.25	4	67-C
18x4.4 (2)(11)	.090	.150	1.25	3.25	4	67-C
18x5.5	.080	.100	----------	3.5	4	15, 67-C
18x5.5 (2)(11)	.090	.150	1.62	3.5	4	67-C
20x4.4 (2)(11)	.090	.150	1.25	3.5	5	67-B
22x5.5 (2)(11)	.090	.150	1.62	4.25	7	67-B
24x5.5 (2)(11)	.090	.150	1.62	4.5	8	67-B
24x7.7	.090	.100	----------	6.0	8	14M
24x7.7 (2)(11)	.090	.150	2.50	6.0	8	14M
25x6.0	.090	.100	----------	4.5	15	68-C
25x6.0 (2)(11)	.090	.150	1.38	4.5	15	68-C
26x6	.080	.120	----------	4.8	8	176A-G
26x6.6	.090	.100	----------	6.0	17	176A-G
26x6.6 (2)(11)	.090	.150	2.00	6.0	17	176A-G
29x7.7 (2)(11)	.090	.150	2.00	7.25	20	102-D
30x6.6 (2)(11)	.090	.150	1.62	7.0	10	168-R
30x7.7 (2)(11)	.090	.150	2.62	7.5	19	176A-D
30x8.8 (2)(11)	.090	.150	2.38	8.1	21	102-D
32x8	.080	.120	----------	7.15	10	14M
32x8.8	.090	.100	----------	8.5	21	176A-D
32x8.8 (2)(9)(11)	.090	.150	3.12 (8)	8.5	21	96-C, 176A-D
34x9.9	.090	.125	----------	10.0	27	150CW, 176A
34x9.9 (2)(11)	.090	.150	3.50	10.0	27	150CW
36x11 (2)(11)	.095	.160	3.75	12.5	16	92-C, 93-D
40x12 (2)(11)	.105	.160	4.25	17.0	40	91-C
44x13 (2)(11)	.115	.160	4.75	22.5	25	193-Bent
46x9 (2)(11)	.095	.160	2.25	13.5 28.5	52	99-B
49x17 (2)(11)	.120	.160	5.88	30.0 1.4	40	193-Bent
56x16 (2)(11)	.120	.160	5.00	2.12 3.0	90	193-Bent
15x6.0-5	.060	.060	----------	3.75 3.25	(3)	67-A
15x6.0-6	.060	.060	----------	7.0	4	20 (10), 67-A
19.5x6.75-8	.060	.060	----------	5.9	6	15
22x7.25-11.50	.065	.090	----------	6.9	6	150CW
22x8.0-8	.060	.085	----------	1.4	7	15
29x6.25-16	.090	.095	----------		20	76-A
29x11.0-10	.070	.095	----------		20	193-Bent
29x13-5	.060	.100	----------		10	262-Bent
380x150-5	.060	.060	----------		(3)	67-A

(1) Measured from centerline of tube base to edge of fabric.
(2) Shall be provided with a fabric base or other suitable reinforcement, ie. protective flap.
(3) Balance not required.
(4) These tubes shall be marked "Drop Center".
(5) These tubes shall be marked "Flat Base".
(6) Must not exceed 45 in-oz with valve extension and must not exceed 20 in-oz without valve extension.
(7) For OV-10 nose wheel, use valve TR 193-Bent.
(8) For dual brake applications, use fabric width of 2.38.
(9) The use of fabric base with the best heat resistant tube is mandatory.
(10) For H-60 tail wheel tube, use valve TR 67-A.
(11) Not recommended for new design and not likely to be procurable.
* Reference TRA Aircraft Yearbook.

TABLE 4 - Valve Attachment Strength Requirements

*Valve TR No.	Minimum Ultimate Load (lb)
60	450
67	500
168	500
176A	800

*Reference TRA Aircraft Yearbook

3.5 Leakage:

All tubes shall be airtight. Paragraph 4.5.6 describes how the tubes shall be checked for leakage by inflating with air and immersing in water. Any indication of bubbling shall be cause for rejection.

3.6 Age:

Tubes shall be not more than 36 months old from the date of manufacture to the initial date of delivery.

3.7 Identification:

3.7.1 Tubes: Each tube shall be legibly and permanently marked with the following information on an external surface:

a. Size

b. Specification (AS50141)

c. Name or trademark of qualified manufacturer

d. Date of manufacture, including at a minimum month and year.

e. The appropriate TR valve number.

3.7.2 Valves: Each valve shall be legibly and permanently marked with the appropriate TR number on an external surface.

3.8 Surface Treatment:

Each tube shall be partially inflated and folded in a manner that will eliminate sharp creases. The tubes shall be protected from injury by the metal valve stem, or components thereof, by means of a suitable non-corrosive material. Each tube shall be treated with powdered soapstone, talc, or a suitable substitute to prevent rubber-to-rubber adhesion when packaged.

3.9 Workmanship:

The tube shall be free from defects that affect proper functioning in service. The tube shall have a smooth finish and be free of tool marks, dirt, and foreign material which affect appearance.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Inspection and Testing Responsibility:

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection and testing requirements as specified herein. The supplier may utilize his own or any other facilities suitable for the performance of the requirements specified herein unless disapproved by the procuring activity. The procuring activity reserves the right to perform any of the inspections or tests set forth in this specification if deemed necessary to ensure conformance to prescribed requirements.

4.2 Classification of Tests:

The inspection and testing of tubes shall be classified as follows:

a. Qualification tests (4.3)

b. Acceptance tests (4.4)

4.3 Qualification Tests:

The qualification test samples shall consist of three tubes of each size on which approval is desired. Samples shall be identified as required and forwarded to an appropriate testing laboratory. Qualification testing shall consist of all the tests of this specification. After completion of the qualification tests, the testing laboratory shall furnish two copies of each qualification test report to the responsible procuring activity if requested.

4.4 Acceptance Tests:

The acceptance tests shall consist of:

a. Individual tests (4.4.1)

b. Sample tests (4.4.2)

4.4.1 Individual Tests: Each tube shall be subjected to the product examination test (4.5.1).

4.4.2 Sample Tests: Unless otherwise specified, samples shall be selected from each lot in accordance with ANSI/ASQC Z1.4 (Inspection Level I, Acceptance Number Zero) and subjected to the following tests:

a. Physical properties/characteristics (4.5.2)

b. Strength of splice (4.5.3)

c. Valve attachment strength (4.5.4)

d. Balance (4.5.5)

e. Leakage (4.5.6)

4.5 Test Methods:

4.5.1 Product Examination Test: Each tube shall be visually examined for conformance to all the requirements of this specification not covered by tests.

4.5.2 Physical Properties/Characteristics Test: All tests of tensile strength, elongation, and set shall be conducted in accordance with ASTM D 412. The methods used for verifying tube weight and valve dimensions, shall be satisfactory to the inspector.

4.5.2.1 Set Test Conditions: Test samples per ASTM D 412, Die B shall be used. Sample thickness shall be 0.080 inch ± 0.008 inch. The sample(s) shall be centered and clamped with the inner edges of the clamps 4.5 inch ± 0.1 inch apart. The sample(s) shall be stretched to achieve 50% elongation of the gage length and then air-heated for a minimum of 5 hours at 107 °C ± 3 °C (225 °F ± 5 °F). Elongation shall not be adjusted during the test.

4.5.2.2 Determination of Set: Following aging, the sample(s) shall be allowed to cool under tension for a minimum of 2 hours. The tension shall then be released and the permanent set in the gage length shall be measured after a 23-hours ± 1-hour dwell period.

4.5.3 Strength of Splice Test: The average strength of a splice shall be determined by averaging the strength of samples taken from the crown, base, and two sides of the tube in accordance with ASTM D 412. For fabric base tubes, only three samples shall be taken (one from the crown and one from each sidewall above point where gum strip ends).

4.5.4 Valve Attachment Strength Test: A section of the tube with valve stem assembly shall be centrally positioned in a valve attachment strength test apparatus similar to that shown in Figure 1. The apparatus shall then be securely clamped in the jaws of a testing machine of such capacity that the tension during test shall not exceed 85% nor be less than 15% of the machine's rated capacity. The stroke speed shall be set at a rate of 0.5 in/min. The ultimate load required to pull out the valve stem shall be recorded as the valve attachment strength.

4.5.5 Balance Test: Each fabric base tube shall be balanced by determining the weight required to produce static balance and attaching an appropriate weight patch to bring the tube within required balance limits. All-rubber tubes shall be sampled for compliance with balance requirements in accordance with the sampling plan.

4.5.6 Leakage Test: Tubes shall be checked for leakage by inflating with air and immersing in water.

4.5.7 Low Temperature Test: A sample of the material shall satisfactorily pass testing in accordance with ASTM D 746 at -50 °C (-58 °F). In addition to the standard test requirement, there shall be no evidence of pending failure of the test samples at a temperature higher than -50 °C (-58 °F). Alternate test methods may be employed provided data is submitted substantiating the equivalence of test methods.

5. PREPARATION FOR DELIVERY:

The following information is provided for reference only, and does not comprise a requirement of this specification.

5.1 Packaging of tubes:

It is recommended that Tubes be packaged in a fiberboard box conforming to ASTM D 5118 and that the total package weight shall not exceed 50 lbs..

Each tube may be sealed individually in clear shrink-wrap or a transparent polyethylene bag of suitable thickness for the size of the tube. Identification of each tube shall be made by use of a paper label secured to the inside of the package or by a pressure sensitive plastic label on the outside.