SAE International™

SURFACE VEHICLE STANDARD

SAE J2435

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Superseding J2435 APR1999

Welded Flash Controlled, SAE 1021 Carbon Steel Tubing, Normalized for Bending, Double Flaring, and Beading

RATIONALE

This five year review of this standard resulted in changes identified by the bar on the left side of the page and are described as follows:

a. Added SAE and other international standards to the "Related Publications" section because these documents are related to SAE J2435 tubing.

b. In Section 8, Performance Requirements, removed un-needed SAE J1677 paragraph numbering to eliminate unnecessary confusion.

c. In Section 8, Performance Requirements, added elongation test.

1. SCOPE

The SAE Standard covers normalized electric resistance welded flash controlled single-wall, SAE 1021 carbon steel pressure tubing intended for use as pressure lines and in other applications requiring tubing of a quality suitable for bending, double flaring, beading, and brazing. Material produced to this specification is not intended to be used for single flare applications due to the potential leak path that would be caused by the ID weld bead.

The grade of material produced to this specification is higher in carbon content and manganese content than the grade of material specified in SAE J356. The material produced to this specification is intended to service higher pressure applications than like sizes of SAE J356. Due to the higher carbon and manganese content, however, the forming characteristics of the finished tube is diminished somewhat when compared to SAE J356. Special attention to the overall forming requirements of the finished assembly should be taken into consideration when utilizing material produced to this specification.

2. REFERENCES

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J356 Welded Flash-Controlled Low-Carbon Steel Tubing Normalized for Bending, Double Flaring, and Beading

SAE J409 Product Analysis—Permissible Variations from Specified Chemical Analysis of a Heat or Cast of Steel

SAE J514 Hydraulic Tube Fittings

SAE J533 Flares for Tubing

SAE J1677 Tests and Procedures for Steel and Copper Nickel Tubing

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this document.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J1065 Nominal Reference Working Pressures for Steel Hydraulic Tubing

SAE J1453 Fitting—O-Ring Face Seal

SAE J2551 Recommended Practices for Fluid Conductor Metallic Tubing Applications

SAE J2592 Carbon Steel Tubing for General Use—Understanding Nondestructive Testing for Carbon Steel Tubing

SAE J2658 Metallic Tube Conductor Assemblies for Fluid Power and General Use—Test Methods for Hydraulic Fluid Power Metallic Tube Assemblies

2.2.2 ISO Publications

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 3305 Plain end welded precision steel tubes—Technical conditions for delivery

ISO 5598 Fluid power systems and components—Vocabulary

ISO 8434-2 Metallic tube connections for fluid power and general use—Part: 2 37° flare fittings

ISO 8434-3 Metallic tube connections for fluid power and general use—Part: 3 ORFS fittings

ISO 10583 Hydraulic fluid power—Test methods for tube connections

ISO 10763 Hydraulic fluid power—Plain-end, seamless and welded steel tubes—Dimensions and nominal working pressures

2.2.3 ASTM Publications

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A 513 Electric-Resistance-Welded Carbon and Alloy Steel Tubing

ASTM A 450/A 450M Standard Specifications for General Requirements for Carbon, Ferritic Alloy and Austenitic Alloy Steel Tubing

3. MANUFACTURE

The tubing shall be made from a single strip of steel shaped into a tubular form, the edges of which are joined and fused by electric resistance welding. After forming and welding, the outside flash shall be removed to provide a smooth surface. The inside flash shall be of uniform contour, free from saw-tooth peaks and controlled in height by seam-welding techniques or by cutting, but not by hammering or rolling. The inside flash height shall conform to the following as in Table 1.

The tubing shall be *normalized* via an atmospherically controlled method to produce a finished product, which will meet all requirements of this document.

TABLE 1 - INSIDE FLASH HEIGHT

Nominal Wall Thickness mm	Maximum Flash Height[(1)(2)] Through 25.4 mm OD mm	Maximum Flash Height Over 25.4 mm OD mm
Less than 0.90	0.13	0.25
0.90 through 1.65	0.20	0.25
Greater than 1.65	0.25	0.25

1. For tubes having an ID greater than 8 mm, the height of the inside weld flash shall be measured with a ball micrometer having a 3.96 mm ± 0.41 mm radius on the anvil or ballpoint. For tubes having an ID 8 mm or less, screw thread micrometers shall be used. The height of the flash shall be the difference between the thickness of the tubing wall at the point of maximum height of the flash and the average of the wall thickness measured at points adjacent to both sides of the flash.
2. Tubing with an ID that is smaller than the producer's capability to scarf the ID weld bead shall be produced as a "flash in" tube. Seam welding techniques may be applied in order to control the ID flash height. The maximum ID flash height, however, will be determined by agreement between the producer and the purchaser.

4. DIMENSIONS AND TOLERANCES

The tolerances applicable to tubing outside diameter are shown in Table 2. The tolerances applicable to tubing wall thickness are shown in Table 3. Particular attention shall be given to areas adjacent to the weld to insure against thin spots and/or sharp indentations.

TABLE 2 - TUBING OUTSIDE DIAMETER TOLERANCE

Nominal Tubing OD[1][2] mm	Tube OD Tolerance ± mm
Up to 9.50	0.06
Over 9.50 to 15.88	0.08
Over 15.88 to 28.57	0.09
Over 28.57 to 50.80	0.13
Over 50.80 to 63.50	0.15
Over 63.50 to 76.20	0.20
Over 76.20 to 88.90	0.23
Over 88.90 to 101.60	0.25

1. OD measurements shall be taken at least 50 mm from the end of the tubing.
2. Refer to SAE J514 for nominal tubing OD to be used in conjunction with standard hydraulic tube fittings and SAE J533 for recommended maximum nominal wall thickness for double flaring.

TABLE 3 - TUBING WALL THICKNESS TOLERANCES

Nominal Wall Thickness[1] mm	Nominal Tubing Outside Diameter Through 25 mm ±[2] mm	Nominal Tubing Outside Diameter Through 50 mm ±[2] mm	Nominal Tubing Outside Diameter Over 50 mm Through 100 mm ±[2] mm
0.71	0.05/0.08	0.08/0.08	0.08/0.08
0.89	0.05/0.10	0.05/0.10	0.05/0.10
1.00	0.05/0.10	0.05/0.10	0.05/0.10
1.25	0.10/0.13	0.08/0.13	0.10/0.20
1.50	0.15/0.15	0.10/0.20	0.10/0.20
1.65	0.15/0.15	0.10/0.20	0.10/0.20
2.00	0.15/0.25	0.15/0.25	0.15/0.25
2.11	0.15/0.25	0.15/0.25	0.15/0.25
2.41	0.15/0.25	0.15/0.25	0.15/0.25
2.50	0.15/0.25	0.15/0.25	0.15/0.25
2.77	0.15/0.25	0.15/0.25	0.15/0.25
3.00	0.15/0.25	0.15/0.25	0.15/0.25
3.05	0.15/0.25	0.15/0.25	0.15/0.25
3.40	0.15/0.25	0.15/0.25	0.15/0.25
3.75	—	0.18/0.28	0.18/0.28
4.00	—	0.18/0.28	0.18/0.28
4.19	—	0.18/0.28	0.18/0.28
4.57	—	0.18/0.28	0.18/0.28
5.00	—	0.20/0.30	0.20/0.30
5.16	—	0.20/0.30	0.20/0.30
5.59	—	0.20/0.30	0.20/0.30
6.00	—	0.36/0.46	0.36/0.46
6.05	—	0.36/0.46	0.36/0.46
6.58	—	0.36/0.51	0.36/0.51

1. For intermediate wall thickness, the tolerance for the next heavier wall thickness shall apply.
2. Plus tolerances include allowance for crown on flat-rolled steel.

5. MANUFACTURING STANDARDS

5.1 Straightness

Tubing shall be straightened to a tolerance of 0.8 mm in 1000 mm. Straightness tolerances shall be measured by placing a 915 mm straight edge against the tube while lying on its neutral axis. The point of maximum deflection of the tube from the straight edge should not be more than allowed by the specification when measured with a feeler gauge.

5.2 Tubing End Condition

The tubing will be produced using normal mill cut-off practices. This will include, but is not limited to, punch-cut ends, double-cut ends, and rotary-cut ends. Care will be taken to minimize the distortion of the tube ends. Distortion of the tube ends must not affect the normal re-cutting processes that will be performed by the end user. Ends that require further processing will be by agreement between the producer and tube purchaser.

5.3 Finish

The outside surface finish of the tube is critical in order to prevent possible leak paths on double flare fittings, mechanical form fittings, or other applications where the outside surface of the tube becomes the sealing surface. The outside surface of the tube shall be free of excessive roll marks, score marks, chatter marks, or other surface imperfections that would be considered detrimental to the function of the tubing.

5.4 Thermal Treatment

The tubing is to be heated to a temperature above the upper transformation point in an atmospherically controlled furnace, and then cooled in a protective atmosphere.

6. MATERIAL

Tubing shall be made from low-carbon, hot- or cold-rolled steel conforming to the chemical composition in Table 4. If rimmed steel is used, it shall be single strand. The steel shall be made by the open hearth basic oxygen or electric furnace process. A ladle analysis of each heat shall be made to determine the percentages of the elements specified. The chemical composition thus determined shall be reported to the purchaser, or his representative, if requested, and shall conform to the requirements specified. If a check analysis is required, the tolerances shall be as specified in SAE J409, Table 3.

TABLE 4 - CHEMICAL REQUIREMENTS

Element	Cast or Heat Analysis, Weight %
Carbon	0.17 min/0.23 max
Manganese	0.60 through 0.90
Phosphorus	0.04 max
Sulfur	0.05 max

7. MECHANICAL PROPERTIES

The finished tubing shall have mechanical properties as tabulated in Table 5.

TABLE 5 - MECHANICAL PROPERTIES

Properties	Values
Yield Strength, min	275 MPa
Ultimate Strength, min	415 MPa
Elongation in 50 mm, min	25%
Hardness(Rockwell B), max	78(1)

1. The hardness test shall not be required on tubing with a nominal wall thickness of less than 1.65 mm. Such tubing shall meet all other mechanical properties and performance requirements.