SURFACE VEHICLE STANDARD

J2467™ MAY2020

Issued 1999-04
Revised 2020-05

Superseding J2467 JUN2015

(R) Welded and Cold-Drawn, SAE 1021 Carbon Steel Tubing Normalized for Bending, Single Flaring, Cold Forming, Welding, and Brazing

RATIONALE

This SAE Standard has been revised as part of a Five-Year Review. Document changes include revisions to the scope and applicable and related documents lists; new verbiage in Section 4 and 5.2; clarified 5.3 surface condition requirement; revised/added notes to 8.8 and 8.9; replaced verbiage with inequality symbols in body of Tables 1 and 3 and heading of Table 2; revised size range and replaced verbiage with inequality symbols in heading of Table 2; revised verbiage placement and added words “minimum” and “maximum” in body of Tables 3 and 4. Verbiage has been updated throughout the standard to align the document with other recently revised bulk tube standards.

1. SCOPE

This SAE Standard covers normalized electric resistance welded, cold-drawn, 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, single flaring, cold forming, welding, and brazing.

The grade of material produced to this specification is higher in carbon content and manganese content than the grade of material specified in SAE J525 and is intended to service higher pressure applications than equivalent sizes of SAE J525. Due to the higher carbon and manganese content, the forming characteristics of the finished tube are diminished versus the SAE J525 product. Special attention to the overall forming requirements of the finished assembly shall be taken into consideration when specifying material produced to this specification. Refer to SAE J2551-1 for additional design and fabrication guidance associated with this material. Nominal working pressures for this material are listed in ISO 10763 and SAE J1065. When required, qualification testing shall be in accordance with ISO 19879.

In an effort to standardize within a global marketplace and ensure that companies can remain competitive in an international market, it is the intent to convert to metric tube sizes, which will:

- Lead to one global system.
- Guide users to a preferred system.
- Reduce complexity.
- Eliminate inventory duplications.

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For more information on this standard, visit
https://www.sae.org/standards/content/J2467_202005

2. REFERENCES

2.1 Applicable Documents

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

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 +1 724-776-4970 (outside USA), www.sae.org.

SAE J403	Chemical Compositions of SAE Carbon Steels
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 J525	Welded and Cold Drawn Low-Carbon Steel Tubing Annealed for Bending and Flaring
SAE J1065	Nominal Reference Working Pressures for Steel Hydraulic Tubing
SAE J1677	Tests and Procedures for Carbon Steel and High Strength Low Alloy Steel Tubing
SAE J2551-1	Recommended Practices for Fluid Conductor Carbon, Alloy and High Strength Low Alloy Steel Tubing Applications - Part 1: Design and Fabrication

2.1.2 ISO Publications

Copies of these documents are available online at http://webstore.ansi.org/.

ISO 10763	Plain-End, Seamless and Welded Steel Tubes - Dimensions and Nominal Working Pressures
ISO 19879	Metallic Tube Connections for Fluid Power and General Use - Test Methods for Hydraulic Fluid Power Connections

2.2 Related Documents

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

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 +1 724-776-4970 (outside USA), www.sae.org.

SAE J518-1	Hydraulic Flanged Tube, Pipe, and Hose Connections, 4-Screw Flange Connection Part 1: 3.5 MPa to 35 MPa (Code 61)
SAE J518-2	Hydraulic Flanged Tube, Pipe, and Hose Connections, 4-Screw Flange Connection Part 2: 42 MPa (Code 62)
SAE J1453-1	Specification for O-Ring Face Seal Connectors: Part 1 - Tube Connection Details and Common Requirements for Performance and Tests

SAE J1453-2 Specification for O-Ring Face Seal Connectors: Part 2 - Requirements, Dimensions, and Tests for Steel Unions, Bulkheads, Swivels, Braze Sleeves, Braze-on Tube Ends, Caps, and Connectors with ISO 6149-2 Metric Stud Ends and ISO 6162 4-Bolt Flange Heads

SAE J1453-3 Specification for O-Ring Face Seal Connectors: Part 3 - Requirements, Dimensions, and Tests for Steel Unions, Bulkheads, Swivels, Braze Sleeves, Caps, and Connectors with SAE J1926-2 Inch Stud Ends

SAE J2435 Welded Flash Controlled, SAE 1021 Carbon Steel Tubing, Normalized for Cold Forming, Welding, and Brazing

SAE J2551-2 Recommended Practices for Fluid Conductor Carbon, Alloy and High Strength Low Alloy Steel Tubing Applications - Part 2: General Specifications and Performance Requirements

SAE J2551-3 Recommended Practices for Fluid Conductor Carbon, Alloy and High Strength Low Alloy Steel Tubing Applications - Part 3: Procurement

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

2.2.2 ISO Publications

Copies of these documents are available online at http://webstore.ansi.org/.

ISO 3305 Plain End Welded Precision Steel Tubes - Technical Conditions for Delivery

ISO 4200 Plain End Steel Tubes, Welded and Seamless - General Tables of Dimensions and Masses per Unit Length

ISO 4397 Connectors and Associated Components - Nominal Outside Diameters of Tubes and Nominal Inside Diameters of Hoses

ISO 4399 Connectors and Associated Components - Nominal Pressures

ISO 5598 Fluid power Systems and Components - Vocabulary

ISO 6162-1 Hydraulic Fluid Power - Flange Connections with Split or One-Piece Flange Clamps and Metric or Inch Screws - Part 1: Flange Connectors, Ports and Mounting Surfaces for Use at Pressures of 3.5 MPa (35 bar) to 35 MPa (350 bar), DN 13 to DN 127

ISO 6162-2 Hydraulic Fluid Power - Flange Connections with Split or One-Piece Flange Clamps and Metric or Inch Screws - Part 2: Flange Connectors, Ports and Mounting Surfaces for Use at a Pressure of 42 MPa (420 bar), DN 13 to DN 76

ISO 6164 Hydraulic Fluid Power - Four-Screw, One-Piece Square-Flange Connections for Use at Pressures of 25 MPa and 40 MPa (250 bar and 400 bar)

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

2.2.3 EN Publications

Copies of these publications are available online at http://webstore.ansi.org/.

EN 10305-2 Steel Tubes for Precision Applications - Technical Delivery Conditions - Part 2: Welded and Cold Drawn Steel Tubes

EN 10305-3 Steel Tubes for Precision Applications - Technical Delivery Conditions - Part 3: Welded Cold Sized Steel Tubes

EN 10305-6 Steel Tubes for Precision Applications - Technical Delivery Conditions - Part 6: Welded Cold Drawn Steel Tubes for Hydraulic and Pneumatic Power Systems

2.2.4 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A513/A513M-15 Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing

ASTM A450/A450M Standard Specifications for General Requirements for Carbon and Low Alloy Steel Tubes

3. MANUFACTURE

The tubing shall be made from a single strip of flat rolled steel shaped into a tubular form, the edges of which are joined and fused together by electric resistance welding. After forming and welding, the tubing shall be normalized and subjected to a cold drawing operation that shall result in a wall thickness reduction of 8% minimum. Subsequent to cold drawing, the tubing shall be normalized via an atmospherically controlled method to produce a finished product that will meet all requirements of this document.

4. DIMENSIONS AND TOLERANCES

The tolerances applicable to the tubing ouside diameter (OD) and inside diameter (ID) are shown in Table 1. The tolerances applicable to tubing wall thickness are shown in Table 2. Dimensional tolerances can only apply to two of the three tubing dimensions (OD, ID, or wall). Unless otherwise agreed upon between the purchaser and producer, dimensional tolerances shall apply to the tube OD and wall dimension.

Table 1 - Tubing diameter tolerances

Nominal Tubing OD[1][2] mm	Tube OD Tolerance ±mm	TUBE ID Tolerance ±mm
≤9.50	0.05	0.05
>9.50 to ≤15.88	0.06	0.06
>15.88 to ≤50.80	0.08	0.08
>50.80 to ≤63.50	0.10	0.10
>63.50 to ≤76.20	0.13	0.13
>76.20 to ≤105.00	0.15	0.15

(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 2 - Tubing wall thickness tolerances

Nominal Wall Thickness[1]	Nominal Tubing Outside Diameter ≤30 mm ±mm	Nominal Tubing Outside Diameter >30 mm to ≤55 mm ±mm	Nominal Tubing Outside Diameter >55 mm to ≤105 mm ±mm
0.89	0.05/0.05	0.05/0.05	0.05/0.05
1.00	0.05/0.05	0.05/0.08	0.05/0.08
1.25	0.05/0.05	0.05/0.08	0.05/0.08
1.50	0.05/0.05	0.05/0.08	0.05/0.08
1.65	0.05/0.05	0.05/0.08	0.05/0.08
2.00	0.05/0.05	0.05/0.08	0.08/0.08
2.11	0.05/0.05	0.05/0.08	0.08/0.08
2.41	0.05/0.05	0.05/0.08	0.08/0.08
2.50	0.05/0.08	0.05/0.10	0.08/0.08
2.77	0.05/0.08	0.05/0.10	0.08/0.08
3.00	0.08/0.08	0.05/0.10	0.08/0.08
3.05	0.08/0.08	0.05/0.10	0.08/0.08
3.40	—	0.05/0.10	0.08/0.08
3.75	—	0.05/0.10	0.08/0.08
4.00	—	0.08/0.10	0.08/0.10
4.19	—	0.08/0.10	0.08/0.10
4.57	—	0.10/0.10	0.08/0.13
5.00	—	0.10/0.13	0.10/0.13
5.16	—	0.10/0.13	0.10/0.13
5.59	—	0.10/0.15	0.10/0.15
6.00	—	0.13/0.15	0.13/0.15
6.05	—	0.13/0.15	0.13/0.15
6.58	—	0.13/0.15	0.13/0.15

(1) For intermediate wall thickness, the tolerance for the next heavier wall thickness shall apply.

5. MANUFACTURING STANDARDS

5.1 Straightness

Tubing shall be straightened to a tolerance of 1 mm over a 1000 mm length.

5.2 Tubing End Condition

The tubing shall be produced using normal mill cut-off practices, e.g., punch-cut ends, double-cut ends, or rotary-cut ends. Tube end distortion must be minimized; end condition shall not affect normal re-cut processes performed by the fabricator, e.g. circular saws, nick and shear, laser, or punch cut processing methods. Extraordinary end cut processing requirements shall be defined by agreement between the producer and purchaser.