

 SURFACE VEHICLE STANDARD	SAE J2879 JUL2011
	Issued 2011-07
Automotive Hydraulic Brake Tube Joints	

RATIONALE

The Rationale for this specification is to create a more robust 90 degree double inverted flare (also known as 45 degree double inverted flare) joint for automotive brake tube joints.

FOREWORD

This Foreword is included with the intention of providing future users with information regarding the background and rationale that guided the development of this standard.

In late 2007, SAE received and accepted a proposal to work on improving the double inverted flare brake tube joint for automotive applications. A Task Force was formed consisting of 3 major OEMs, along with numerous tube, tube nut, and mating port suppliers. All agreed that the current joint should be evaluated for improvements based on current industry practices and knowledge of joint sealing.

Sealing mechanisms for the joint were discussed. While it was commonly thought that the flare deformed, bending down to match the port, analysis of sectioned parts and X-rays of assembled parts did not prove out this mechanism. Instead, the majority of the deformation needed to seal comes from deformation of the port cone.

Investigation of the specifications currently used for automotive applications (SAE J533, SAE J512, SAE J527, and JASO F402:2001) revealed that the compatibility of dimensions and tolerances were not always optimized for joint sealing robustness. Also, the flare/nut/port specifications did not maintain the same relative geometry as the nominal tube size changed. The Task Force set out to build on the prior standards and improve these elements.

The philosophy followed by the Task Force was as follows:

- Historically, joints with larger tube diameters exhibited less sealing robustness than those with smaller tube diameters resulting in higher installation torques for the larger diameter joints - therefore the 3/16 in joint design was targeted as the baseline.
- As tube size increases, the features of the components should remain identical in size and interaction with each other, so that the cross-section of a component or an assembled joint changes only by shifting the center line to represent the new diameter.
- Dimensions and tolerances of each component should be adjusted to relate to mating components in a way that reflects the evolution of understanding of the sealing mechanisms present in the joint.
- To promote treatment of the joint as a system, all three components of the joint are described in a single standard instead of separate component standards.

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Joints that sealed well (particularly 3/16 in flares) suggested the following guidelines for updating the standards:

- The top of the cone seat of the port should contact toward the middle of the flare sealing surface.
- The tube nut should contact the back of the flare towards the outer diameter of the flare.
- Last full thread to top of cone is a critical port dimension for control of thread engagement.
- A minimum port depth is required to ensure proper thread engagement along with all other dimensions.

Starting then with the 3/16 in joint, the Task Force selected component dimensions based on all existing standards to optimize all the required component interactions. They then extrapolated by shifting the joint centerline to find the resulting dimensions for 1/4 in, 5/16 in, 4.75 mm, 6.0 mm and 8.0 mm joints. These sizes were chosen because they are in common use in brake applications. Both metric tube sizes and English tube sizes were included in the specification.

Users can differentiate this joint from other inverted flare joints by the presence of the 0.5 mm lead-in on the tube nut. This feature is unique from joints using SAE J512 or the JASO F402 standard.

All dimensions in this specification have been developed to work together to optimize joint sealing and manufacturability, and modification is not recommended.

Lessons Learned

Current standards did not actively control minimum thread engagement to the level that the Task Force members determined was important for the joint. Cone seat-to-thread and cone/flare/tube nut stackups were performed, scrutinized and revised over many months to prevent the tube nut from running out of threads when installed to the port and to ensure three threads minimum engagement between nut and port for the entire tolerance range. Note: running out of threads results in torque going into cutting new threads instead of generating clamp load.

Cone seat wall thickness (port cone OD versus through hole) in this specification is consistent across all sizes. Some deformation of the cone when assembled has been historically acceptable and can improve sealing robustness.

Flare thickness variation (TV) control is key to robust joint sealing. A flare with a large difference in thickness from maximum to minimum can result in the thick side being captured between nut and seat while the thin side has no contact. This situation is detrimental to sealing robustness. Current manufacturing methods limit the ability to specify this dimension to the level recommended for optimal joint sealing robustness (0.08 mm) in SAE Paper 2009-01-1029. Since 0.08 mm is not currently achievable 0.20 was included in this standard. Efforts should continue at flare manufacturers to improve flare TV capability as manufacturing methods evolve, in order to reduce TV tolerances.

Traditional surface finish measurement of Ra or Rz was questioned as to whether these were the best indicators of tube flare surface quality for sealing given the manufacturing process used to form tube flares. One large impression (e.g., 50 micron) in a sealing surface can cause a leak, however, Ra or Rz would be nearly unaffected by this type of defect because they average the values measured. It was concluded that Ra or Rz alone are not enough to prevent surface defects that could result in leaks. Rt was considered and eventually adopted based on benchmarking surface finish data on other types of flares. It measures the maximum peaks and valleys without averaging, making it more sensitive to factors that affect the sealing of this joint.

The back surface of the tube flare has had little dimensional control historically. The task force discussed adding a flat area for the tube nut to contact. However defining the surface and the ability to measure it in practice proved quite difficult. In order to not abandon the idea, a reference callout was added saying the area should be flat within specified gage diameters.

Extensive stack-up and dimensional analysis was performed to establish common relationships between parts, across tube sizes, and within common supply base manufacturing practices. No rounding of dimensions was done for the final specification. This resulted in some non-symmetric tolerances for some dimensions. The reason for not rounding to create fully symmetric tolerances is so that future users can re-run dimensional analyses and reach the same conclusions or results as the Task Force that developed this specification.

1. SCOPE

This document applies to 90 degree double inverted flares used on common sizes of automotive hydraulic brake tubes, and their associated tube nuts and mating ports. The intent of this standard is to replace the use of SAE J512 and SAE J533 for automotive hydraulic brake tube connections.

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

SAE J527 Brazed Double Wall Low-Carbon Steel Tubing

2.1.2 ANSI Publications

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

ANSI/ASME B1.13M Metric Screw Threads – M Profile

2.1.3 ASME Publications

Available from American Society of Mechanical Engineers, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, Tel: 973-882-1170, www.asme.org.

ASME Y14.5M GD&T

2.1.4 DIN Publications

Available from DIN Deutsches Institut für Normung e. V. – DIN German Institute for Standardization, Burggrafenstraße 6 / DIN-Platz, 10787 Berlin, Germany, Phone: +49 30 2601-0, Fax: +49 30 2601-1231, <http://www.din.de/cmd?level=tpl-bereich&menuid=47562&cmsareaid=47562&languageid=en>

DIN 13 Metric Screw Threads

2.1.5 ISO Publications

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

ISO 965 Metric Screw Threads

ISO 898-2 Hex sizes

2.2 Related Publications

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

Kapanowski, M. and Callahan, J., "The Effects of Flare Component Specifications on the Sealing of Double Inverted Flare Brake Tube Joints," SAE Technical Paper 2009-01-1029, 2009, doi:10.4271/2009-01-1029.

Pliassounov, S.I., "Fundamentals and Common Problems of Seal Integrity Robustness of Standardized Brake Tubing Threaded Connectors," SAE Technical Paper 2007-01-0557, 2007, doi:10.4271/2007-01-0557.

2.2.2 JASO Publications

Available from JSAE, 10-2 Gobancho, Chiyoda-Ku, Tokyo, 102-0076 Japan, Tel: +81-3-3262-8211(03-3262-8211 for domestic call) FAX: +81-3-3261-2204, E-mail: webmaster@jsae.or.jp, http://www.bookpark.ne.jp/jsae/book_e.asp

JASO F402:2001 Automotive Parts - Flare Fittings

3. DEFINITIONS

All GD&T in the details of Section 4 are based on ASME Y14.5M

4. TECHNICAL REQUIREMENTS

Unless otherwise noted, all dimensions are in millimeters.

This specification was developed based on automotive hydraulic brake component materials commonly used in 2010 (steel, aluminum, brass, and grey iron).

Components, joints, and assembly processes developed using SAE J2879 must be validated by the user to ensure that joint performance meets requirements specific to the application.

4.1 Double flares shall meet the requirements of Figure 1, Table 1, and the corresponding notes.

4.2 Tube nuts shall meet the requirements of Figure 2, Table 2, and the corresponding notes.

4.3 Ports shall meet the requirement of Figure 3 and Table 3 or Figure 4 and Table 4 and the corresponding notes. Figure 3 and Figure 4 show two optional port designs. Figure 3 shows a chamfer version and Figure 4 shows counterbore version. Either port will work with the flares and nuts defined in this specification. The user and manufacturer must decide which style to use.

4.4 No chatter marks permissible on any machined sealing surfaces.