SURFACE VEHICLE STANDARD

J3117™/4 MAR2026

Issued 2026-03

10BASE-T1S (UTP and J-UTP) Unshielded Balanced Single Twisted Pair Ethernet Cable

RATIONALE

This document was developed for 10 Mb/s (10BASE-T1S) Ethernet shared bus application.

TABLE OF CONTENTS

1. SCOPE 3
1.1 Application 3

2. REFERENCES 3
2.1 Applicable Documents 3
2.1.1 SAE Publications 3
2.1.2 ASTM Publications 3
2.1.3 IEEE Publications 3
2.1.4 ISO Publications 3
2.1.5 Other Publications 4

3. DEFINITIONS 4

4. GENERAL 5
4.1 Classification 5
4.1.1 Temperature Classes 5
4.2 General Test Conditions 5
4.3 Ovens 5
4.4 Tolerances 5
4.5 Representative Conductor Sizes for Testing 6

5. GENERAL SPECIFICATIONS 6
5.1 Cable Type 6
5.1.1 Single Core ISO Cable 6
5.1.2 Single Core SAE Cable 6
5.1.3 Outer Jacket (Sheath) 7
5.2 Construction 7
5.3 Cable Breaking Strength 7
5.4 Ovality of Jacket (Sheath) 7
5.4.1 Test 7
5.4.2 Requirement 7
5.5 Scrape Abrasion of Jacket (Sheath) 7
5.5.1 Test 8
5.5.2 Requirement 8
5.6 Electrical (RF) Performance 8

SAE Executive Standards Committee Rules provide that: “This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user.”

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2026 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, or used for text and data mining, AI training, or similar technologies, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 1-877-606-7323 (U.S. and Canada only)
Tel: 1-724-776-4970 (outside U.S. and Canada)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

For more information on this standard, visit
https://www.sae.org/standards/content/J3117/4_202603/

Documents Document Sharing Hub
Full document details: SAE J3117-4-2026 10BASE-T1S (UTP and J-UTP) Unshielded Balanced Single Twisted Pair Ethernet Cable

5.6.1 Test Temperature 8
5.6.2 Characteristic Impedance 10
5.6.3 Insertion Loss (IL) 10
5.6.4 Return Loss (RL) 12
5.6.5 Conversion Loss (LCTL) 13

6. NOTES 14
6.1 Revision Indicator 14

APPENDIX A EXAMPLES OF ETHERNET CABLES 15
APPENDIX B PREFERRED COLOR COMBINATIONS 16
APPENDIX C ETHERNET JACKET COLORS 17

Figure 1 Jacketed (J-UTP) and un-jacketed (UTP) Ethernet cable 7
Figure 2 Example of test fixture for heat aging test at TCR 9
Figure 3A Insertion loss (IL) for 15-m and 25-m cable 11
Figure 3B Total insertion loss requirement for the channel (calculated from 10-m length test sample measurements) 12
Figure 4 Return loss (RL) requirement 13
Figure 5 Conversion loss requirement (LCTL) 14

Table 1 S-parameter 5
Table 2 Temperature class rating (TCR) 5
Table 3 General specifications 6
Table 4 10BASE-T1S Ethernet cable construction 7
Table 5 Needle scrape abrasion protection level 8
Table 6 Test temperature for initial “as received” sample 8
Table 7 Test temperature after 3000 hours heat aging 9
Table 8 Recommended characteristic impedance 10
Table 9 Insertion loss 11

Documents
Document Sharing Hub
Full document details: SAE J3117-4-2026 10BASE-T1S (UTP and J-UTP) Unshielded Balanced Single Twisted Pair Ethernet Cable

1. SCOPE

This SAE Standard covers a single Un-Jacketed (UTP) and Jacketed (J-UTP) Balanced Unshielded Twisted Pair data cable intended for use in surface vehicle cables for 10 Mb/s Ethernet shared bus applications. The tests in this document are intended to qualify cables for normal operation in an automotive environment while maintaining the necessary electrical properties for reliable data transmission.

1.1 Application

The cable was developed for 10BASE-T1S Ethernet PHY shared bus applications.

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 (U.S. and Canada only) or +1 724-776-4970 (outside U.S. and Canada), www.sae.org.

SAE J1678 Low Voltage Ultra-Thin Wall Primary Cable

EA-1128 Wire Color Charts

2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9500, www.astm.org.

ASTM D5374 Standard Test Methods for Forced-Convection Laboratory Ovens for Evaluation of Electrical Insulation

ASTM D5423 Standard Specification for Forced-Convection Laboratory Ovens for Evaluation of Electrical Insulation

2.1.3 IEEE Publications

Available from IEEE Operations Center, 445 and 501 Hoes Lane, Piscataway, NJ 08854-4141, Tel: 732-981-0060, www.ieee.org.

IEEE Std 802.3 10BASE-T1S Single Pair Ethernet

2.1.4 ISO Publications

Copies of these documents are available online at www.iso.org/store.

ISO 19642-2 Road Vehicles - Automotive Cables, Test Methods

ISO 19642-3 Road Vehicles - 60 V Single Core Cables - Test Methods, Dimensions and Requirements.

ISO 19642-7 Road vehicles - Round, Sheathed, 60 V Screened and Unscreened Single- or Multi-Core Cables - Test Methods and Requirements for Basic- and High-Performance Cables

Documents
Document Sharing Hub
Full document details: SAE J3117-4-2026 10BASE-T1S (UTP and J-UTP) Unshielded Balanced Single Twisted Pair Ethernet Cable

2.1.5 Other Publications

Available from OPEN Alliance website, www.opensig.org.

Channel and Component Requirements for 10BASE-T1S Link Segment, Version 1.0 (February 14, 2025).

3. DEFINITIONS

For the purposes of this document, the following terms and definitions apply.

3.1 CROSSTALK

A measurement of the unwanted signal transmitted from one aggressor circuit or channel of a transmission system to the victim circuit or channel (for two or more channels in the same bundle).

3.2 IMPEDANCE (Z)

The total opposition to alternating current by an electric circuit equal to the square root of the sum of the squares of the resistance and reactance of the circuit; usually expressed in ohms and is denoted as Z.

3.3 INSERTION LOSS (ATTENUATION)

The loss of signal power resulting from the insertion of a device in a transmission line and is usually expressed in decibels (dB). This is the s-parameter defined as Sdd_{21} or Sdd_{12}.

3.4 J-UTP

Jacketed (sheathed) unshielded twisted pair.

3.5 LCTL (LONGITUDINAL CONVERSION TRANSMISSION LOSS)

A ratio, expressed in decibels (dB), of the common mode (CM) signal applied between the wires in a pair and the resulting differential mode (DM) noise signal transmitted from one end to the other end. This is the s-parameter defined as Sdc_{21} and Sdc_{12}.

3.6 LOW VOLTAGE (LOW TENSION)

Usually considered to be ≤60 VDC (25 VAC).

3.7 MINIMUM WALL (THICKNESS)

The lowest allowable insulation thickness at any point.

3.8 NOMINAL

A suitable approximate value used to designate or identify a component.

3.9 PHY

Abbreviation for the physical layer device. A PHY connects a link layer device to a physical medium such as a copper cable or optical fiber. A PHY chip (PHYceiver) is commonly found on Ethernet devices. Its purpose is to provide analog signal physical access to the link.

3.10 RETURN LOSS

A ratio expressed in decibels (dB) of the power of the outgoing signal to the power of the reflected or returned signal. This is the s-parameter defined as Sdd_{11} and Sdd_{22}.

AVA Documents
Document Sharing Hub

Full document details: SAE J3117-4-2026 10BASE-T1S (UTP and J-UTP) Unshielded Balanced Single Twisted Pair Ethernet Cable

3.11 S-PARAMETER

Table 1 - S-parameter

Single Channel Characteristics (port 1,2)		
RL	S_{dd11}, S_{dd22}	Return loss (differential mode)
IL	S_{dd21}, S_{dd12}	Insertion loss (differential mode)
LCTL	S_{dc12}, S_{dc21}	Longitudinal conversion transmission loss

3.12 TCR (TEMPERATURE CLASS RATING)

A class designation based on the long-term heat aging (3000 hour) test.

3.13 UTP

Unshielded twisted pair (un-jacketed).

3.14 WCC

Whole communication channel is the complete electrical wire connection between two ECUs.

4. GENERAL

4.1 Classification

4.1.1 Temperature Classes

Four cable classes have been defined in Table 2 to respond to the various temperatures encountered on vehicles.

Table 2 - Temperature class rating (TCR)

Class	Operating Temperature	Equivalent to Temperature Class	Typical Usage
A	-40 to 85 °C	T1	Interior wiring harness (IP, body, headliner, doors, liftgate)
B	-40 to 100 °C	T2	Engine bay, forward lamp
C	-40 to 125 °C	T3	Engine
D	-40 to 150 °C	T4	On engine, behind engine

4.2 General Test Conditions

Test samples shall be preconditioned for at least 16 hours at a room temperature of 23 °C ± 3 °C. Unless otherwise specified, all tests shall be conducted at this same temperature. All samples shall pass. In the case where the test result is based on an average, the average shall meet the requirement.

4.3 Ovens

Unless otherwise specified, when an oven is required, it shall be a hot air oven in accordance with ASTM D5374 and ASTM D5423. The air contained in the oven shall be completely changed at least eight times but not more than 20 times per hour at the specified temperature.

4.4 Tolerances

Unless otherwise specified, all values are considered to be approximate.

Documents
Document Sharing Hub
Full document details: SAE J3117-4-2026 10BASE-T1S (UTP and J-UTP) Unshielded Balanced Single Twisted Pair Ethernet Cable

4.5 Representative Conductor Sizes for Testing

When a test is required, all combinations of conductor size, wall thickness, and insulation formulation shall meet the appropriate requirements.

5. GENERAL SPECIFICATIONS

The finished cable shall meet the requirements for all tests specified in Table 3.

Table 3 - General specifications

Clause	Description	Initial Tests	Periodic Tests(4)
4	GENERAL SPECIFICATIONS		
5.1	Cable Types		
5.1.1	Single Core ISO Cable	X(1)	
5.1.2	Single Core SAE Cable	X(1)	
5.1.3	Outer Jacket (Sheath)	X(2)	
5.2	Construction	X	X
5.3	Cable Breaking Strength	X	X
5.4	Ovality of Jacket (Sheath)	X(2)	X(2)
5.5	Scrape Abrasion of Jacket (Sheath)	X(3)	X(3)
5.6	Electrical Performance		
5.6.1	Test Temperature	X	X
5.6.2	Characteristic Impedance	X	X
5.6.3	Insertion Loss	X	X
5.6.4	Return Loss	X	X
5.6.5	Conversion Loss	X	X

(1) Test the individual core cable to either ISO 19642-3 or SAE J1678.
(2) The usage of this test is established by agreement between the customer and supplier.
(3) This requirement is established between the customer and supplier. Testing on heat aged samples is not required.
(4) Electrical performance testing is not required on heat aged samples for periodic testing.

5.1 Cable Type

Each insulated conductor (core) within the UTP and J-UTP cable shall meet the test and performance requirements of the following sections in ISO 19642-3 (2019) or SAE J1678 (2020). Performance requirements include electrical, mechanical, and environmental requirements.

For all cable types, the resistance to the flame propagation test is performed on the finished cable only and not on the individual cores.

5.1.1 Single Core ISO Cable

The two cores within the Ethernet cable shall meet ISO 19642-3 (2019) Sections 5.3 through 5.5.

5.1.2 Single Core SAE Cable

The two cores within the Ethernet cable shall meet SAE J1678 (2020) Sections 6.3 through 6.16.

Documents
Document Sharing Hub
Full document details: SAE J3117-4-2026 10BASE-T1S (UTP and J-UTP) Unshielded Balanced Single Twisted Pair Ethernet Cable