INTERNATIONAL STANDARD

ISO 19095-4

First edition
2015-08-01

Plastics — Evaluation of the adhesion interface performance in plastic-metal assemblies —

Part 4:
Environmental conditions for durability

Plastiques — Évaluation des performances de l'interface d'adhérence dans les assemblages plastique-métal —

Partie 4: Conditions environnementales pour la durabilité

Reference number
ISO 19095-4:2015(E)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

ISO 19095 consists of the following parts, under the general title *Plastics — Evaluation of the adhesion interface performance in plastic-metal assemblies*:

— *Part 1: Guidelines for the approach*

— *Part 2: Test specimens*

— *Part 3: Test methods*

— *Part 4: Environmental conditions for durability*

Introduction

Structures of heterogeneous materials are being manufactured in the automobiles and aerospace industry sectors where higher safety margins are required.

The existing test methods are not appropriate because the evaluation of the adhesive interface is difficult as the polymer material has a relatively low mechanical strength and therefore fractures outside the joints. Therefore, it is necessary to develop a methodology for the evaluation of the adhesive interfaces.

A test method to evaluate accurately the adhesion interface performance or standardization of long-term evaluation under harsh environments is also necessary.

The method in ISO 19095 is intended to ensure that the integrity of the joint is realized through the interface and that traceability of the value improves the data comparison.

This part of ISO 19095 defines the conditions to evaluate the long-term durability.

Plastics — Evaluation of the adhesion interface performance in plastic-metal assemblies —

Part 4: Environmental conditions for durability

SAFETY STATEMENT — Persons using this part of ISO 19095 should be familiar with normal laboratory practice, if applicable. This part of ISO 19095 does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any regulatory conditions. It is recognized that some of the materials permitted in this part of ISO 19095 might have a negative environmental impact. As technological advances lead to more acceptable alternatives for such materials, they will be eliminated to the greatest extent possible. At the end of the test, care should be taken to dispose of all waste in an appropriate manner in accordance with local regulations.

1 Scope

This part of ISO 19095 specifies the environmental conditions to evaluate the durability for the adhesion interface performance in plastic-metal assemblies.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 472, *Plastics — Vocabulary*

ISO 19095-1:2015, *Plastics — Evaluation of the adhesion interface performance in plastic-metal assemblies —Part 1: Guideline for the approach*

ISO 19095-2, *Plastics — Evaluation of the adhesion interface performance in plastic-metal assemblies — Part 2: Test specimens*

ISO 19095-3, *Plastics — Evaluation of the adhesion interface performance in plastic-metal assemblies — Part 3: Test methods*

IEC 60068-2-11, *Basic environmental testing procedures — Part 2-11: Tests — Test Ka: Salt mist*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472 and the following apply.

3.1
shear stress
τ
<fatigue test> stress determined by dividing the force by the bonded surface area

Note 1 to entry: It is expressed in megapascals (MPa).

3.2
static shear stress
τ_R
<fatigue test> average static shear stress at rupture as determined by ISO 4587

Note 1 to entry: It is expressed in megapascals (MPa).

3.3
stress cycle
<fatigue test> smallest part of the stress/time function which is repeated at regular intervals

Note 1 to entry: It is of sinusoidal form (see Figure 1) with undulating shear.

Note 2 to entry: Cyclic stress can be considered to be the superposition of an alternating stress on a static stress which is the mean stress.

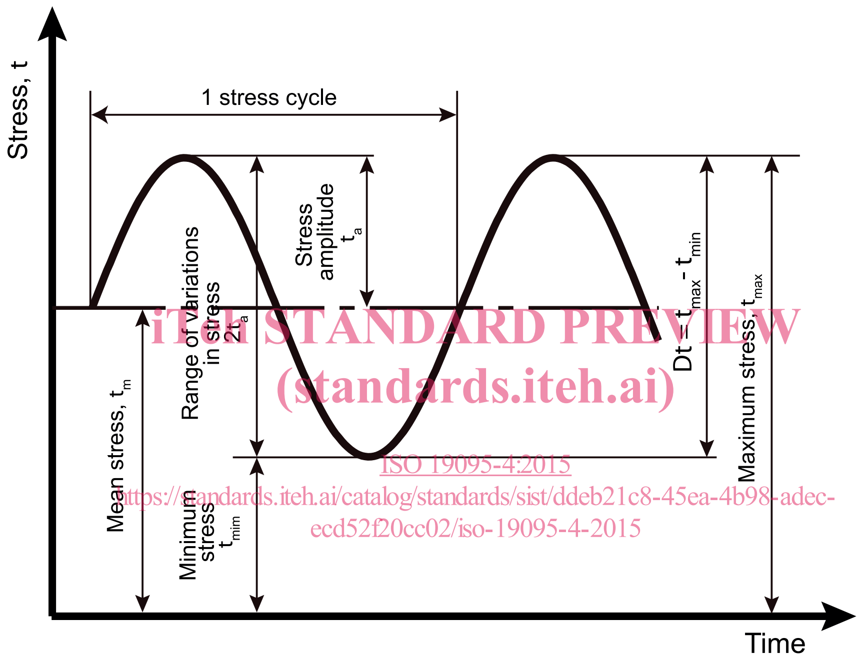


Figure 1 — Fatigue stress cycle

3.4
maximum stress
τ_{max}
<fatigue test> greatest algebraic value reached at regular intervals by the stress

Note 1 to entry: It is expressed in megapascals (MPa).

3.5
minimum stress
τ_{min}
<fatigue test> smallest algebraic value reached at regular intervals by the stress

Note 1 to entry: This stress shall always be positive and is expressed in megapascals (MPa).

3.6
mean stress
τ_m
<fatigue test> algebraic mean of the maximum and minimum stresses

Note 1 to entry: It is expressed as:

$$\tau_m = \frac{\tau_{max} + \tau_{min}}{2}$$

3.7
stress amplitude
τ_a
<fatigue test> alternating stress equal to half the algebraic difference between the maximum and minimum stresses

Note 1 to entry: It is expressed in megapascals (MPa).

Note 2 to entry: It is expressed as:

$$\tau_a = \frac{\tau_{max} - \tau_{min}}{2}$$

3.8
fatigue limit
τ_D
<fatigue test> limiting value which the stress amplitude τ_a approaches when the number of cycles becomes very large, for a given mean stress τ_m

Note 1 to entry: For some materials, stress amplitude versus the number of cycles does not reach a limiting value but decreases constantly on increasing the number of cycles. In this case, it is useful to determine a limit of endurance.

3.9
limit of endurance
$\tau_D(N_F)$
<fatigue test> shear stress determined at a specific number of fault test cycles N_F

Note 1 to entry: It is expressed in megapascals (MPa).

Note 2 to entry: The tests are carried out at constant τ_m, and the results should be presented in the form:

$\tau_D(N_F, \tau_m)$ in megapascals (MPa)

3.10
service life
N
<fatigue test> number of stress cycles applied to a specimen until it has reached the chosen end of the test

Note 1 to entry: Where it has not failed, the service life is not defined but is termed greater than the test duration.

3.11
cycle ratio
n/N
<fatigue test> ratio of the number of applied cycles (n) to the service life (N)

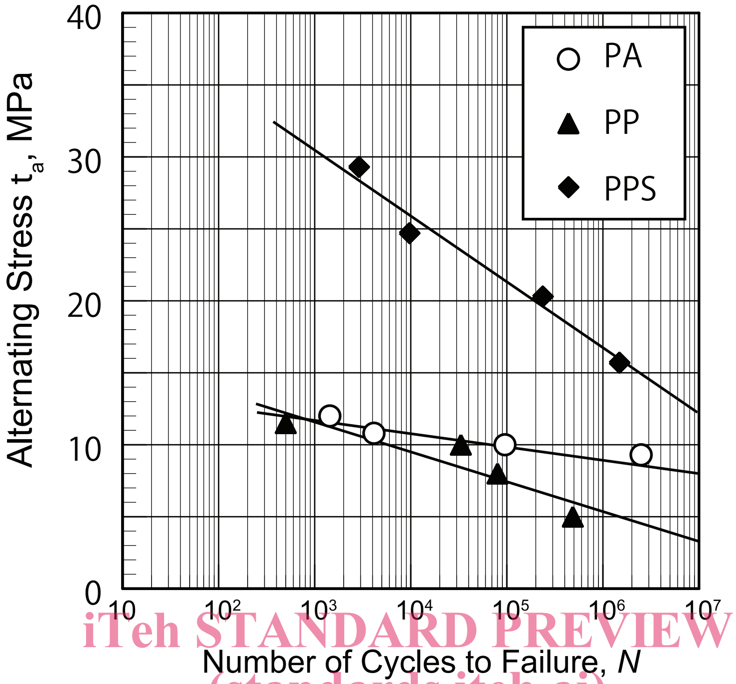
Note 1 to entry: This ratio is used in tests with load bearings, together with an SN curve (Woehler's curve).

3.12
SN curve
<fatigue test> curve, allowing the resistance of the material to be seen, which indicates the relationship observed experimentally between service life N, shown conventionally in abscissae (logarithmic scale) and stress τ_a or τ_{max} shown in ordinates in linear scale (typical curve in Figure 1)

Note 1 to entry: This curve is established by keeping τ_m constant. The SN curve is defined by the relationship between amplitude of stress and service life. On this curve (Figure 2), we can distinguish

— the endurance zone where, for a given stress, failures as well as non-failures for a number of fault test cycles NF can be identified, and

— the fatigue zone where, for a given stress, all the specimens fail at the end of a number of cycles less than the number of conventional fault test cycles N_F mentioned above.



Key

PA polyamide

PP polypropylene

PPS polyphenylene sulfide

Figure 2 — Semi-logarithmic plots of typical SN curves of plastic-aluminium 5052 assemblies tested at 30 Hz at room temperature

4 Test specimen

4.1 Form of test specimen

See ISO 19095-2.

4.2 Condition of test specimen

See ISO 19095-3.

5 Test procedure

5.1 Temperature dependence test

5.1.1 Apparatus

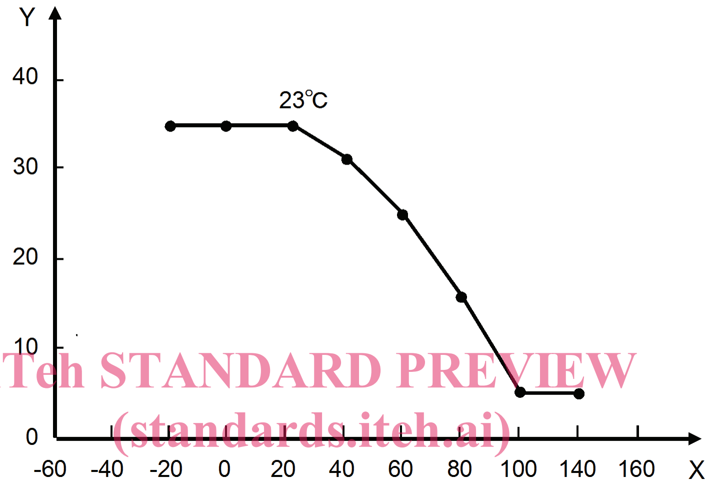
See ISO 19095-1.

5.1.2 Test procedure

After keeping the test specimen under the condition described in ISO 19095-1 for 48 h, select the corresponding temperature groups from (−40 ± 3) °C, (−20 ± 3) °C, (0 ± 2) °C, (40 ± 2) °C, (60 ± 2) °C, (80 ± 2) °C, (100 ± 2) °C, (120 ± 3) °C, (140 ± 2) °C, (160 ± 3) °C, and (180 ± 2) °C and carry out the test. The test specimen shall be kept at the specified temperature for 10 min.

5.1.3 Presentation of result

Based on the strength in respective temperature obtained in 5.2, develop a strength-temperature line graph. Figure 3 shows an example.



Key

X temperature (°C)

Y strength (MPa)

Figure 3 — Sample line graph of strength-temperature

5.2 Thermal shock test

5.2.1 Apparatus

See ISO 19095-1.

5.2.2 Test procedure

After keeping the test specimen under the condition described in ISO 19095-1 for 48 h, leave the test specimen in a constant low temperature chamber preset to (−40 ± 3) °C for (2 ± 0,5) h.

Take the test specimen out from the chamber and place it immediately in the chamber adjusted to the high temperature shown in Table 1, and repeat the temperature cycle as specified in Table 1 and Figure 4.

Respectively, after 10, 50, 100, 200, 500, 1 000 repetitions of the temperature cycle, take the test specimen out from the chamber, leave it under the condition described in ISO 19095-1 for more than 2 h, and carry out the test.

